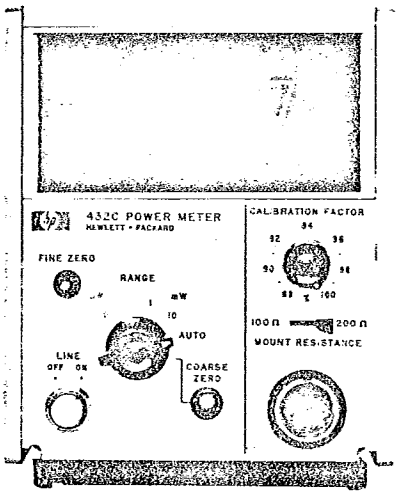
SUPPLEMENT D FOR 00432-90009

POWER METER

432C

SERIALS PREFIXED 1129A



OCTOBER 1971

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1. GENERAL INFORMATION

2. Description

3. The Hewlett Packard Model 432C Power Meter has a digital readout, automatic ranging, and remote programming capability. It uses the same meter circuits used in the HP 432A analog power meter: the only electrical and mechanical differences between the two instruments are those that have to do with Digital Panel Meter M1, Auto Range Assembly A6, and data input/output connector J6.

4. This supplement is intended to be used with the 432A Operating and Service Manual and covers the changes necessary to document the 432C. When the serial number prefix on the serial number plate of your instrument matches the serial prefix listed on the cover of this supplement, the supplement applies directly to your instrument. When the instrument serial number prefix is not listed on the cover, a yellow "Manual Changes" sheet is provided to update this supplement.

5. Accessories

6. Accessories supplied with, and available for, the 432C are the same as those for the 432A.

7. Options

8. Options for the 432C are the same as those for the 432A except that Option 001, rechargable battery, is not available.

9. INSTALLATION

10. Installation procedures for the 432C are the same as those for the 432A except for those that deal with internal battery operation.

Table 1. Specifications

Instrument Type: Automatic, self-balancing power meter for use with temperature-compensated thermistor mount.

Power Range: Four ranges with full scale readings of 10 and 100 μW, and 1 and 10 mW.

Accuracy: ±0.5% of full scale on 100 μW, and 1 and 10 mW ranges (20° to 30°C); ±1.0% on 10 μW range. ±1.5% of full scale on all ranges (±0° to +55°C).

Noise: Less than 0.25% of full scale peak.

Response Time: At Recorder Output, 35 ms time constant (typical).

Fine Zero: Automatic, operated by front panel switch or remote input.

Zero Carryover: Less than 0.50% of full scale when zeroed on most sensitive range.

Calibration Factor Control: 13-position switch normalizes meter reading to account for thermistor mount Calibration Factor. Range 100% to 88% in 1% steps.

RFI: Meets all conditions specified in MIL-I-6181D.

Meter: Three digits with one digit overrange. 20% overrange capability on all ranges.

Thermistor Mount: External temperature-compensated thermistor mounts required for operation (HP 478, 8478B, and 486 series; mount resistance 100 or 200 ohms).

Recorder Output: Proportional to indicated power with 1 volt corresponding to full-scale. 1 kΩ output impedance.

BCD Output: 8, 4, 2, 1 code: "1" positive. TTL compatible logic. Operates with HP 5055A Digital Recorder. "Print" and "Inhibit" lines available.

Bridge Outputs (V_{RF} and V_{COMP}): Direct connections to the thermistor bridges; used in instrument calibration and precision power measurements.

Control Lines: (Note: Instrument is referenced to +5V true. "Logical 1", refers to +5V, "Logical 0" is equivalent to 0V):

Outputs: BCD Output as described above.

Overrange: Single bit indicates meter overrange.

Underrange: Single bit indicates meter underrange.

Range: 2 Bit code indicates range selected.

Table 1. Specifications (Cont'd.)

Print: Single bit indicates data is ready.

Inputs:

Remote Enable: Single bit establishes control of instrument ranging and fine zero controls for remote programming. Remote fine zero may be accomplished in remote or local modes of operation.

Remote Range: Two bit code selects instrument range.

Auto Zero: Contact closure to ground zeros meter.

Inhibit: Single bit holds data and stops A/D Converter.

Ext. Trig: When in inhibit mode, single bit starts new data conversion. Data Ready in 10 msec.

Power: 115 or 230V AC ±10%, 50 to 400 Hz, 16 watts.

Weight: Net, 7 lb. (3,2 kg).

Dimensions: 6-9/16 in. high, 5-1/8 in. wide, and 11 in. deep (163 X 130 X 279 mm).

Accessories Furnished: 5 ft. (1,52 m) cable for HP temperature-compensated thermistor mounts; 7-1/2 ft. (2,29 m) power cable.

Accessories Available:

8404A Power Meter Leveling Amplifier (for use with HP 8690B or 8620 sweepers).

8477A Power Meter Calibrator.

11076A, Carrying Case.

5060-0797 Rack Adapter Frame (holds three instruments the size of the 432C).

Combining Cases:

1051A, 11-1/4 in. (286 mm) deep.

1052A, 16-3/8 in. (416 mm) deep.

The combining cases accept the 1/3-module HP instruments for bench use or rack mounting.

Options:

002: Input connector placed on rear panel in parallel with front.

003: Input connector on rear panel only.

NOTE

Thermistor mount cable impedance is part of the 432C input bridge circuit. For cables over 10 feet long the bridge is matched to specific cable options, so the various cables should not be interchanged.

009: 10-foot (3,05 m) cable for 100-ohm or 200-ohm mount.

010: 20-foot (6,10 m) cable for 100-ohm or 200-ohm mount.

011: 50-foot (15,24 m) cable for 100-ohm or 200-ohm mount.

11. OPERATING INFORMATION

12. Introduction

13. The 432C operates the same as the 432A with with the following exceptions:

a. No battery operation

b. Ranges are 10 and 100 μW, 1 and 10 mW, and Auto.

c. Unit is remotely programmable.

d. Greater meter accuracy (see Table 1).

e. Data input/output at rear panel.

14. Auto Ranging

15. If Range Switch S5 is set to AUTO, the 432C Power Meter will automatically select the correct range. When the digital panel meter reads 1200 or higher, the display will momentarially

blank and the power meter will switch to the next higher range. When the digital panel meter reads 0099 or less, the power meter will switch to the next lower range. It takes the power meter 500 msec to make an analog to digital conversion and switch to the next higher or lower range.

16. Data Input/Output at J6

17. Connector J6, on the rear panel, provides data input/output capability that is TTL compatible. The 432C uses positive true logic: logical "1" refers to +5V (actually +3.5V ±1V) and logical "0" refers to 0V (actually +0.2V ±0.2V). Figure 1 shows J6 and lists its pin functions.

18. BCD Output. Binary Coded Decimal information that duplicates the numbers shown on the digital panel meter is provided in an 8421 code (see Table 2).

Digit		Weight	Pin Number
Units	10^0A	1	1
	10^0B	2	2
	10^0C	4	26
	10^0D	8	27
Tens	10^1A	1	3
	10^1B	2	4
	10^1C	4	28
	10^1D	8	29
Hundreds	10^2A	1	5
	10^2A	2	6
	10^2C	4	30
	10^2D	8	31
Thousands	10^3A	1	7
	10^3B	2	8 (ground)
	10^3C	4	32 (ground)
	10^3D	8	33 (ground)

19. Underrange/Overrange Output. The Underrange Flag is set when the meter reads 0099 or less; the Overrange Flag is set when the meter reads 1200 or more.

Condition	Pin 16	Pin 15
On Range	0	0
Underrange	0	1
Overrange	1	0

Table 2. BCD Output

Decimal	Binary			
	8	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

20. Range Output. The current range setting of the power meter is indicated by the range outputs.

Range	Range 2 (pin 12)	Range 1 (pin 11)
10 μW	0	0
100 μW	0	1
1 mW	1	0
10 mW	1	1

21. Print Output. A transition, on pin 48, from 1 to 0 signifies that data is ready. Normally, the Print command does not appear until the power meter has auto ranged to the correct range, or is set to the correct range by the front panel switch or the remote range inputs. However, the Print command will appear, even if the power meter is overranged or underranged, if the jumper (E1) on Auto Range Assembly A6 is connected between jumper pins B and C (see Service Sheet 5).

22. Ground and +5V Outputs. Pin 50 provides a ground reference for the logic circuits in the 432C. Pin 45 provides +5V (at 100 mA max) that can be used to power an interface or print device.

23. Remote Enable Input. A logical 0 (or contact closure to ground) on pin 21 puts the 432C in remote mode. The front panel RANGE and FINE ZERO switches are disabled, and the meter is under control of the Remote 1, Remote 2 and Auto Zero inputs.

24. A logical 1 (or open circuit) on pin 21 puts the 432C in local mode. The meter is under control of the front panel RANGE and FINE ZERO switches and the Remote 1 and Remote 2 inputs

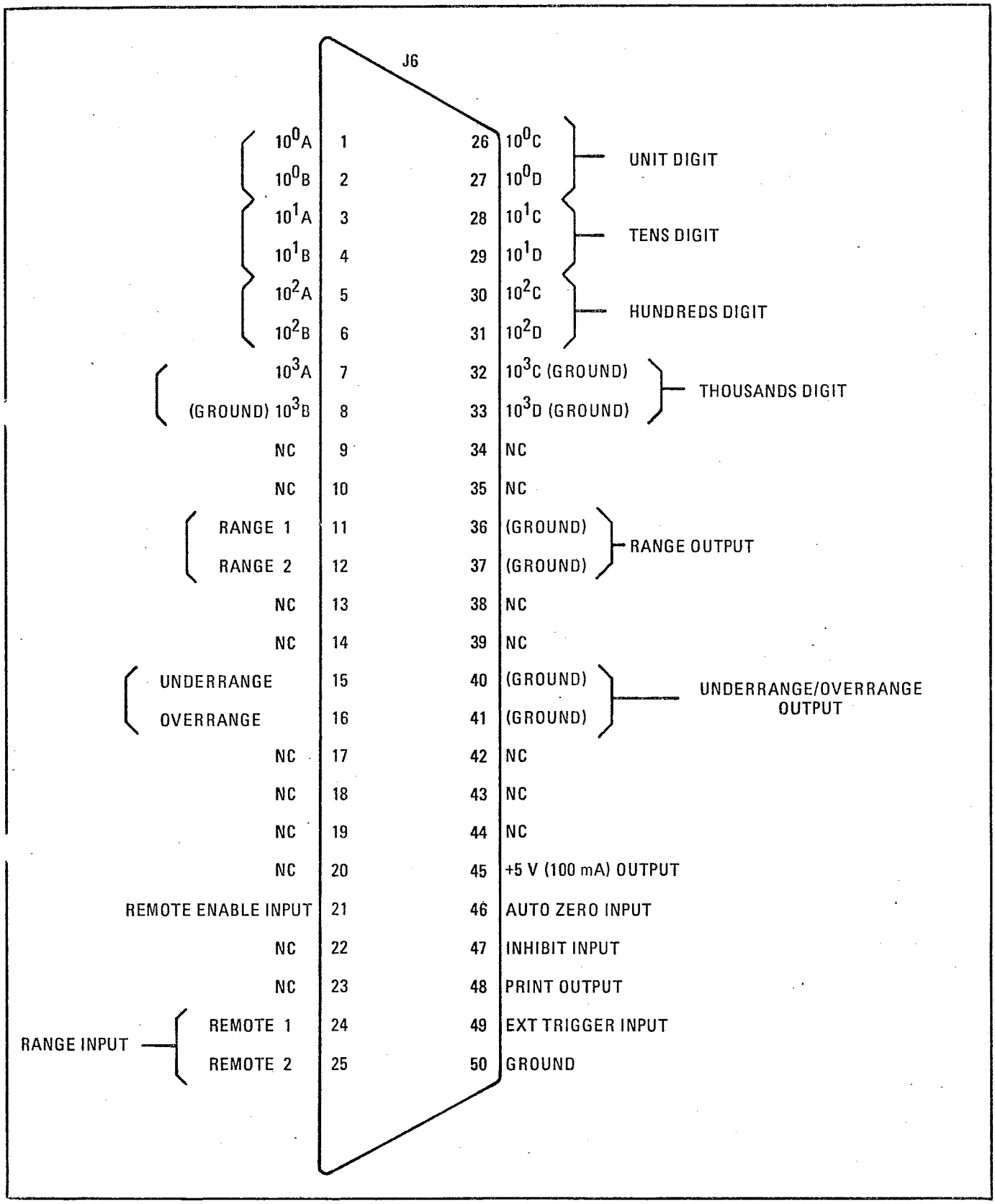


Figure 1. Data Input/Output Connector J6

are disabled. However, the meter can be zeroed using the Auto Zero input.

NOTE

Since the logic circuitry in the 432C is TTL compatible, an open circuit is equivalent to logical 1 (+5V).

25. **Remote Range Inputs.** The remote range inputs control range selection in remote mode (when Remote Enable is 0). They are disabled in local mode.

Range	Remote 2 (pin 25)	Remote 1 (pin 24)
10 μW	0	0
100 μW	0	1
1 mW	1	0
10 mW	1	1

26. **Auto Zero Input.** A logical 0 on pin 46 zeros the meter in either remote or local mode.

27. **Inhibit Input.** A logical 0 on pin 47 holds data and stops the analog to digital converter. A logical 1 starts an A/D conversion on the next 500 msec cycle.

28. **External Trigger Input.** With a logical 0 on the Inhibit input, a transition from logical 1 to logical 0 on the External Trigger input starts an A/D conversion immediately. Data is ready in 10 msec.

NOTE

Normally the Print output will indicate a data ready condition only if the power meter is on the correct range; to get a Print output regardless of an underrange or overrange condition, connect the jumper (E1) on Auto Range Assembly A6 between jumper pins B and C.

29. Operation With HP Model 5055A Digital Recorder

30. To use the 432C with the HP 5055A Digital Recorder, connect the recorder to the power meter with an HP 562-16C interface cable (supplied with HP 5055A Option 02.) Set the recorder for a +8421 BCD code; turn blanking on (this blanks insignificant zeros). Table 3 shows data interpretation.

Table 3. 432C/5055A Data Interpretation

Column	Interpretation
1 (right)	Units Digit
2	Tens Digit
3	Hundreds Digit
4	Thousands Digit
5	Blank
6	Range Code*
7	Blank
8	Overrange/Underrange**
9	Blank
10 (left)	Blank

* Range Code: 0 = 10 μW Range
1 = 100 μW Range
2 = 1 mW Range
3 = 10 mW Range

** 0 = Correct Range, 1 = Underrange, 2 = Overrange

31. PRINCIPLES OF OPERATION

32. General

33. The 432C operation is the same as the 432A except that Digital Panel Meter M1 accepts the analog information from Meter Logic Assembly A2. Also, all range switching (manual, auto and remote) is performed by circuits on Auto Range Assembly A6. Operation of Thermistor Bridge Assembly A1 and of Meter Logic Assembly A2 is the same in both instruments.

34. Digital Panel Meter M1 (see Service Sheet 4)

35. The digital panel meter, a self contained analog to digital converter, contains its own power supply, converter, decoder driver and display. The unit is *not* field repairable; see paragraph 84 for meter exchange information.

36. Auto Range Assembly A6

37. **Introduction** (see Figure 2). Auto Range Assembly A6 comprises the logic circuitry and relays that set the power meter to its four basic ranges. The main control element is the up/down counter. The counter generates a range code that

consists of four binary counts, or states. The range code corresponds to the meter's four ranges:

Range Code	Range
00	10 μW
01	100 μW
10	1 mW
11	10 mW

The counter's range code is decoded by the decoder drivers. The drivers energize and de-energize the relays that set the range of the power meter (see Service Sheet 2).

38. The range code can also be supplied by external logic circuitry through the Remote Enable, Remote 1 and Remote 2 input lines. When these inputs are being used, the up/down counter still functions but is isolated from the decoder drivers by the remote/local switch.

39. The up/down counter is controlled by the Underrange and Overrange Flags. The Overrange Flag is set by circuitry in Digital Panel Meter M1 whenever the meter reads 1200 or higher. The Underrange Flag is set by the underrange decoder (located on the A6 assembly) whenever the meter reads 0099 or lower.

40. An Overrange Flag causes the up/down counter to count up, increasing the range setting of the power meter. An Underrange Flag causes the counter to count down, decreasing the range setting of the power meter. However, if the counter is at range code 11 (10 mW range) and receives an Overrange Flag, it will not cycle to range code 00 (10 μW range). Likewise, if the counter receives an Underrange Flag when it is at range code 00, it will not cycle to range code 11.

41. The Underrange and Overrange Flags control the up/down counter only when Range Switch S5 is set to AUTO. If the switch is set to COARSE ZERO or one of its four range positions, it directly sets the counter to a range code that corresponds to the switch setting. The counter is then unaffected by the flags.

42. **Up/Down Counter Inputs** (see Service Sheet 5). When Range Switch S5 is set to AUTO, the up/down counter is controlled by the Underrange Flag, the Overrange Flag and the End of Read bit.

43. The End of Read bit is generated by Digital Panel Meter M1 every time the meter completes an analog to digital conversion. The bit is a transition from 1 to 0 and triggers monostable multivibrator A6U8. The multivibrator's output is a delayed positive pulse that clocks (at its trailing edge) the flip-flops in the up/down counter. The compliment of the Clock pulse is used to gate A6U10A. OR gate U10A feeds a Print pulse (logical 0) to rear panel connector J6 whenever both:

a. J/K_1 and J/K_2 are 0 (i.e. whenever the counter is not counting up or down).

b. U10A gets a low Clock pulse from U8.

This prevents the Print pulse from being sent to J6 while the power meter is on an incorrect range (i.e. while it is auto ranging itself). Connecting jumper E1 between pins B and C feeds the End of Read bit directly to connector J6, whether the counter is on the correct range or not.

44. The Overrange Flag is generated by Digital Panel Meter M1 whenever the meter reads 1200 or higher. It is fed to the up/down counter and to rear panel connector J6 (see Service Sheet 4). The Overrange Flag is a logical 1.

45. The underrange decoder generates an Underrange Flag whenever the Digital Panel Meter reads 0099 or lower. When the hundreds bits and thousands bit are logical 0, pin 9 of NOR gate A6U2C is low. When the End of Read bit (negative going transition) arrives at U2C pin 8, a positive (logical 1) Underrange Flag is generated.

46. **Up/Down Counter** (see Service Sheet 5). The up/down counter comprises dual J/K master/slave flip-flop A6U11, AND-NOR-INVERT gates A6U4 and U6, and inverters A6U7E and U7F. The counter's output is a two-bit range code, 0 to three in binary, that corresponds to the four meter ranges:

Range	Range 2	Range 1
10 μW	0	0
100 μW	0	1
1 mW	1	0
10 mW	1	1

When the counter receives an Overrange Flag, it counts up; when it receives an Underrange Flag, it counts down.

47. There are two flip-flops, one for each range bit. They are controlled (in auto mode) by their Clock and J/K inputs. If a J/K input is high (logical 1) when a Clock pulse arrives, the flip-flop toggles, and the Q output changes states (changes from 0 to 1 or from 1 to 0). If a J/K input is low when a Clock pulse arrives, the Q output does not change.

48. The J/K inputs to the flip-flops are set by A6U4, U6, U7E and U7F. When an Underrange or an Overrange Flag is set, U4 and U6 "decide" whether to set J/K_1 or $J/\overline{K_1}$ and J/K_2 high to make the counter count up or down. The "decision" depends upon both:

a. Whether an Underrange or an Overrange Flag is received.

b. The current count (range code) of the counter. Figure 3 diagrams the decision making capacity of U4 and U6.

49. The J/K flip-flops also have Preset and Clear inputs. A low (logical 0) input to Preset sets a flip-flop's Q output to 1, and a low input to Clear sets the Q output to 0. When either Preset or Clear is low, the J/K and Clock inputs are internally disabled.

50. Range Switch S5 is connected to the Preset and Clear inputs of the flip-flops. When RANGE is set to AUTO, the Preset and Clear inputs are logical 1 and the flip-flops respond to their J/K and Clock inputs. When RANGE is set to any other position, it directly controls the flip-flops:

Range	Clear 2	Preset 2	Q_2	Clear 1	Preset 1	Q_1
10 μW	0	1	0	0	1	0
100 μW	0	1	0	1	0	1
1 mW	1	0	1	0	1	0
10 mW	1	0	1	1	0	1
AUTO	1	1	–	1	1	–
COARSE ZERO	1	0	1	0	1	0

51. **Remote/Local Switch**(see Service Sheet 5). A6U9 and associated invertors, A6U7A, U7B and U7D, function as a double throuw, double pole switch under control of the Remote Enable input. If Remote Enable is logical 1 (i.e. an open circuit) the range busses (R_2 and R_1, $\overline{R_2}$ and $\overline{R_1}$) are connected to the outputs of flip-flops A5U11a and U11B. If Remote Enable is logical 0 (i.e. grounded), then the range busses are connected to the Remote 2 and Remote 1 input lines. Thus, the range code can be supplied by either the up/down counter or the remote inputs.

52. **Decoder Drivers** (see Service Sheet 5). Decoding from the range code (R_2 and R_1, $\overline{R_2}$ and $\overline{R_1}$) to the logic functions required to drive the decimal points, lamps, and reed relays is done by A6U2, U3, U5 and A6Q1 through Q3. The truth table for the decoder drivers is shown below. Note that a contact closure to ground is required to energize a relay or a lamp and is signified by a logical 0; a logical 1 indicates that the lamp or relay is de-energized.

53. **Auto Zero Circuits** (see Service Sheet 4). A6Q6 and Q7 supply −13V to front panel RANGE and FINE ZERO switches when the Remote Enable line is a logical 1 (open circuit). This allows front panel control of the coarse and fine zero functions.

Range	K1	K2	K3	K4	K5	K6	DS2(μW)	DS3(mW)
10 μW	1	1	1	0	0	1	0	1
100 μW	1	0	1	1	0	1	0	1
1 mW	1	1	0	1	1	0	1	0
10 mW	0	1	1	1	1	0	1	0

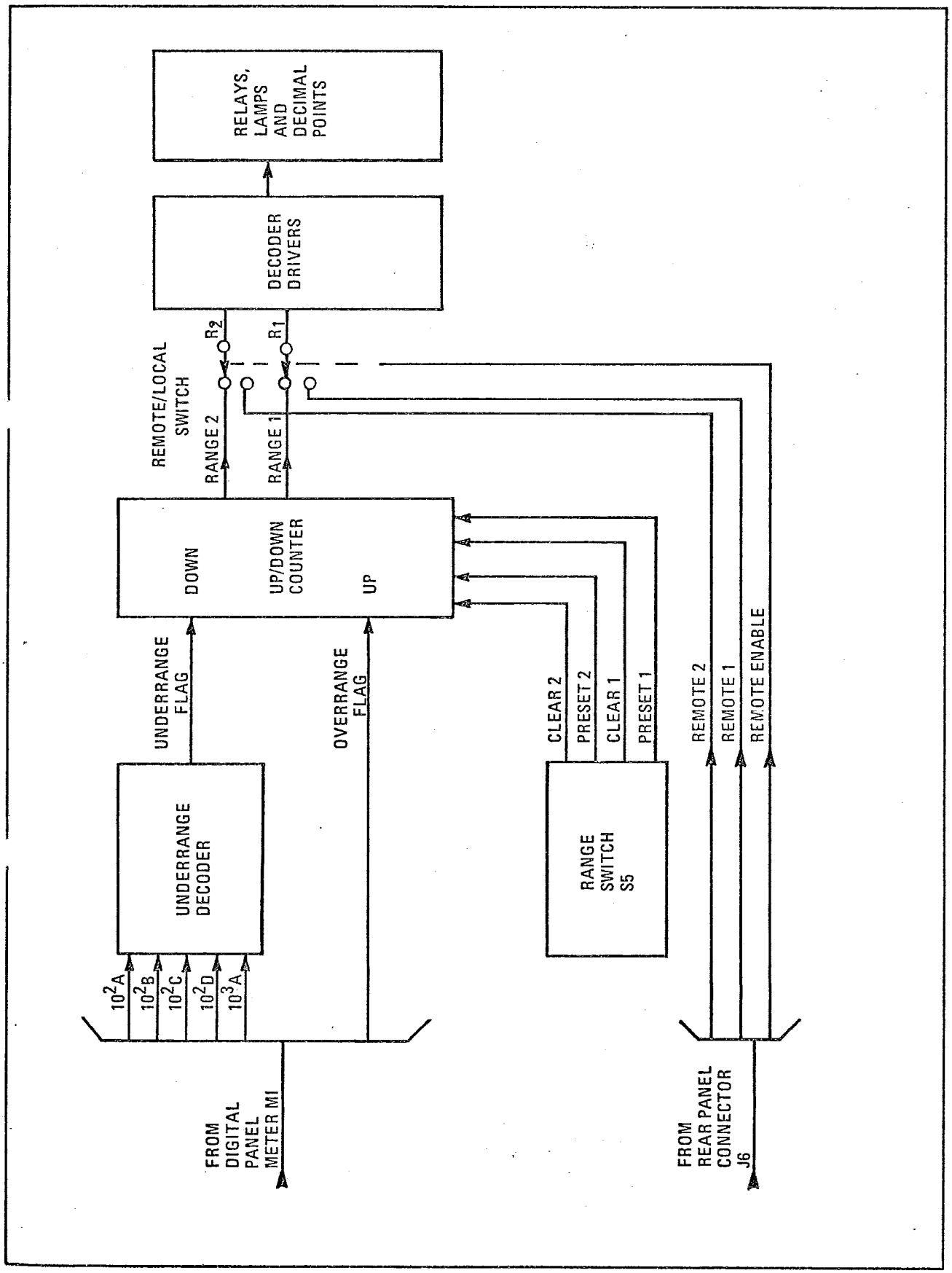


Figure 2. Up/Down Counter Block Diagram

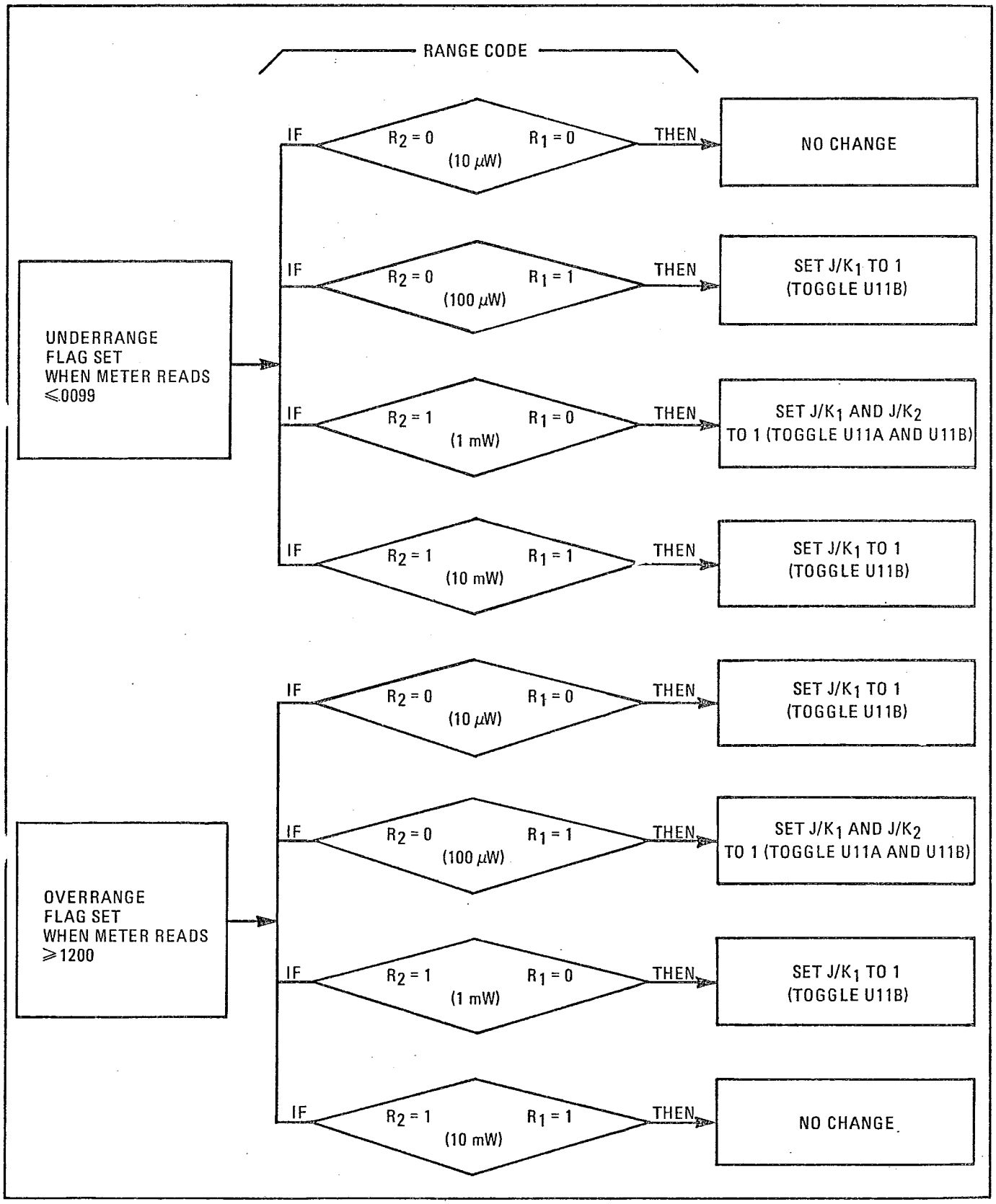


Figure 3. Up/Down Count Sequence

Range	Decimal Point 1	Decimal Point 2	Decimal Point 3
10 μW	1	0	1
100 μW	0	1	1
1 mW	1	1	0
10 mW	1	0	1

54. During remote operation, when the Remote Enable line is a logical 0 ($\overline{\text{Remote Enable}}$ is a logical 1), A6Q6 turns off, turning off A6Q7. This prevents front panel control of the coarse and fine zero functions.

55. Whenever the Auto Zero input is a logical 0, 6Q4 and A6Q5 turn on, supplying −13V to the fine zero circuits on Thermistor Bridge Assembly A1. This action is independent of the Remote Enable input.

56. **Power Supply Circuits** (see Service Sheet 3). The +5V that supplies the integrated circuits on Auto Range Assembly A6 is provided by A6U1 and associated components. A6U1, a monolithic voltage regulator, controls Q1; the conduction of Q1 is regulated to provide +5V at test point 2.

57. PERFORMANCE TESTS

58. The performance tests are suitable for incoming inspection, periodic evaluation, and troubleshooting. Use the recommended test equipment listed in Table 5-1 of the 432A manual with the following changes:

a. Change the filter network (see Figure 4).

b. Add a digital printer with TTL logic levels and +8421 BCD code — HP 5055A Digital Recorder with HP 562-16C interface cable.

c. Add the remote control test set (see Figure 5).

59. The following performance tests replace those documented in the 432A manual.

WARNING

Voltages potentially dangerous to life are present at the power supply transformer pins and at the Digital Panel Meter M1 connectors.

60. METER ACCURACY TEST

SPECIFICATION:

Accuracy:

Instrument Uncertainty: ±0.5% on 100 μW and 1 and 10 mW ranges, ±1.0% on 10 μW range (20° −30°C) ±1.5% max. on all ranges (0° −55°C) ±1.0% typical.

Zero Uncertainty: ± one count on all ranges.

DESCRIPTION: Meter accuracy is checked with an 8477A Calibrator. At the same time, RECORDER output is checked with a digital voltmeter.

EQUIPMENT:

Calibrator	HP 8477A
Digital Voltmeter	HP 3440A/3443A
Cable Assembly (2)	HP 10503A
Cable Assembly	HP 11000A

PROCEDURE:

a. Connect the digital voltmeter and the calibrator to the 432C (see Figure 5 1 in the 432A manual). the 8477A Calibrator controls as follows:

POWER (MW)	0.01 mW
FUNCTION	200Ω
ZERO/TEST	ZERO

b. Set the 432C controls as follows:

MOUNT RESISTANCE	200Ω
RANGE	10 μW
POWER	ON
CALIBRATION FACTOR	100%
A2S1	CALIBRATE

NOTE

A2S1 is located at the top of the left hand circuit board (Meter Logic Assembly A2).

PERFORMANCE TESTS

60. METER ACCURACY TEST (Cont'd)

c. Adjust 8477A ZERO knob for 0.00 μW ±0.01 μW indication on the 432C.

−0.01 _____ +0.01 μW

d. Set 8477A ZERO/TEST to TEST.

e. The digital voltmeter should indicate 1000 ±10 millivolts.

990 _____ 1010 mVdc

f. The 432C meter should indicate 10 μW ±0.1 μW.

9.90 _____ 10.10 μW

g. Repeat steps d through f for each of the other ranges. Set the power meter range selector to the position indicated in Column 1 of Table 4 and set the 8477A meter reading selector to the corresponding osition indicated in Column 2 of Table 4. In each case, the meter indications should correspond to those shown in Table 4, Columns 3 and 4.

h. After completing tests, set A2S1 to OPERATE.

Table 4. Meter Accuracy Test

432C Range	8477A Range (mW)	Digital Voltmeter Indication (millivolts)	432C Meter Indication		
10 μW	.01	1000 ± 10	10 ± 0.1 μW	9.9 _____	10.1
100 μW	0.1	1000 ± 5	100 ± 0.5 μW	99.5 _____	100.5
1 μW	1	1000 ± 5	1.0 ± 0.005 mW	0.995 _____	1.005
10 μW	10	1000 ± 5	10.0 ± 0.05 mW	9.95 _____	10.05

61. METER LINEARITY TEST

SPECIFICATION: Same as Meter Accuracy Test.

DESCRIPTION: A calibrator is used to check meter linearity.

EQUIPMENT:

Calibrator . . . . . HP 8477A
Cable Assembly (2) . . . . . HP 10503A

PROCEDURE:

a. Connect the calibrator to the 432C. Set the 8477A POWER (MW) selector to 1 mW, FUNCTION to 200Ω and ZERO/TEST switch to TEST.

b. Set the 432C RANGE selector to 10 mW, MOUNT RESISTANCE to 200Ω. Set A2S1 to CALIBRATE.

c. The 432C meter should indicate 1 ±0.05 mW

0.95 _____ 1.05 mW

PERFORMANCE TESTS

61. METER LINEARITY TEST (Cont'd.)

d. Set the 8477A POWER (MW) selector to 2 mW.

e. The 432C meter should indicate 2 mW ±0.05 mW

1.95 _____ 2.05 mW

f. Set the 8477A POWER (MW) selector to 3 mW.

g. The 432C meter should indicate 3 mW ±0.05 mW

2.95 _____ 3.05 mW

h. After completing tests, set A2S1 to OPERATE.

62. CALIBRATION FACTOR TEST

SPECIFICATION: Range 100% to 88% in 1% steps.

DESCRIPTION: A calibrator is used to check the accuracy of the calibration factor circuits.

EQUIPMENT:

Calibrator	HP 8477A
Cable Assembly (2)	HP 10503A

PROCEDURE:

a. Connect the calibrator to the 432C, and set 432C controls as follows:

RANGE	100 μW
CAL FACTOR	88%
MOUNT RESISTANCE	200Ω
A2S1	CALIBRATE

b. Set 8477A controls as follows:

FUNCTION	200Ω
ZERO/TEST Switch	TEST
POWER (mW)	0.1 mW

c. Set 8477A ZERO control so that the 432C reads 100 ±0.1 μW.

9.99 _____ 100.1 μW

d. Set the CALIBRATION FACTOR selector to 89%.

e. The 432C should indicate 98.9 ±0.5 μW.

98.4 _____ 99.4 μW

f. Repeat steps d and e for each position of the CALIBRATION FACTOR selector. In each case, the digital voltmeter should indicate the voltage shown in the second column of Table 5 for the CALIBRATION FACTOR shown in the first column.

g. After completing tests, set A2S1 to OPERATE.

PERFORMANCE TESTS

62. CALIBRATION FACTOR TEST (Cont'd.)

Table 5. Calibration Factor Test

Calibration Factor Selector Setting (%)	432C Reading (μW)	
88	100.0 ± 0.1	99.9 _____ 100.1
89	98.9 ± 0.5	98.4 _____ 99.4
90	97.8 ± 0.5	97.3 _____ 98.3
91	96.7 ± 0.5	96.2 _____ 97.2
92	95.7 ± 0.5	95.2 _____ 96.2
93	94.6 ± 0.5	94.1 _____ 95.1
94	93.5 ± 0.5	93.0 _____ 94.0
95	92.6 ± 0.5	92.1 _____ 93.1
96	91.6 ± 0.5	91.1 _____ 92.1
97	90.7 ± 0.5	90.2 _____ 91.2
98	89.7 ± 0.5	89.2 _____ 90.2
99	88.9 ± 0.5	88.4 _____ 89.4
100	88.0 ± 0.5	87.5 _____ 88.5

63. ZERO CARRYOVER TEST

SPECIFICATION: Less than 0.5% of full scale when zeroed on most sensitive range.

DESCRIPTION: 432C is zeroed with a thermistor mount and zero carryover is checked.

EQUIPMENT:

Thermistor Mount . . . . . HP 478A or 8478B

PROCEDURE:

a. Set 432C MOUNT RESISTANCE to resistance shown on the thermistor mount.

b. Connect the thermistor mount to the 432C (A2S1 should be set to OPERATE). Allow the 432C to warm up at least 5 minutes.

c. Zero the 432C as follows:

1) Set the RANGE selector maximum cw to COARSE ZERO.

2) Set the COARSE ZERO screwdriver adjustment so that the meter indicates zero.

3) Set 432C RANGE switch to 10 μW. Depress the FINE ZERO switch. The meter indication should go to zero without overshoot.

d. With the FINE ZERO switch held down, the 432C should read 0 μW ± 0.01 μW

−0.01 _____ +0.01 μW

e. Release FINE ZERO. Rotate the RANGE switch clockwise, one step at a time. On each range the 432C should read within 5 counts of zero, as shown in Table 6.

63. ZERO CARRYOVER TEST (Cont'd.)

Table 6. Zero Carryover

Range	Meter Reading	
100 μW	00.0 ± 0.5 μW	−0.5 _____ +0.5
1 mW	0.000 ± 0.005 mW	−0.005 _____ +0.005
10 mW	0.00 ± 0.005 mW	−0.005 _____ +0.005

64. FINE ZERO RANGE TEST

SPECIFICATION: Automatic, operated by front panel switch.

DESCRIPTION: The fine zero circuits are checked for their ability to zero the meter.

EQUIPMENT:

Thermistor Mount . . . . . HP 478A or 8478B

PROCEDURE:

a. Connect the thermistor mount to the 432C. Set MOUNT RESISTANCE to the resistance shown on the mount. Set RANGE to 1 mW (A2S1 should be set to OPERATE).

b. Turn the COARSE ZERO screwdriver adjustment full ccw.

c. Depress FINE ZERO and hold it down five seconds. The fine zero circuit is now at one end of its range.

d. Release FINE ZERO.

e. Turn COARSE ZERO cw until the meter reads 0.3 ± 0.001 mW.

0.299 _____ 0.301 mW

f. Depress FINE ZERO. The fine zero circuit goes to the other end of its range. The meter should indicate below 0.20 mW.

_____ 0.20 mW

g. Re-adjust COARSE and FINE ZERO to zero the meter.

65. NOISE TEST

SPECIFICATION: Less than 0.25% of full scale peak.

DESCRIPTION: An oscilloscope is connected through a low pass filter (used to eliminate line noise) to RECORDER output. The 432C is then checked for circuit noise.

PERFORMANCE TESTS

65. NOISE TEST (Cont'd.)

EQUIPMENT:

Thermistor Mount	HP 478A or 8478B
Oscilloscope	HP 141A/1401A/1420A
Filter	(See Figure 4)
Cable Assembly	HP 10503A

PROCEDURE:

a. Connect the thermistor mount to the 432C; connect the oscilloscope, through the filter, to RECORDER output with the BNC cable assembly.

b. Set the 432C controls as follows:

RANGE	10 μW
MOUNT RESISTANCE	200 Ω
A2S1	OPERATE

c. Set the oscilloscope controls as follows:

Vertical Deflection	1 mV/div
Horizontal Deflection	2 sec/div
Input	dc

d. Zero the 432C, then read the circuit noise directly on the oscilloscope; any trace deflection should be less than 5 mVp-p.

_____ 5 mVp-p

e. To assemble the line noise filter for the RECORDER output noise test, proceed as follows:

1. Obtain the following parts: BNC connectors — 1 male, 1 female; resistor — 10K ohm; capacitors — 4.7 μF and 100 μF.
2. Assemble the parts as shown in Figure 4.

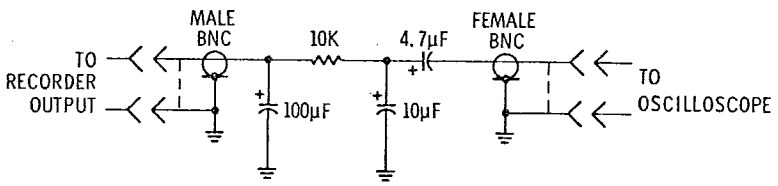


Figure 4. Noise Test Filter Schematic Diagram

66. DATA OUTPUT AND DIGITAL PANEL METER TEST

SPECIFICATIONS:

Meter: Three digits with one digit overrange. 20% overrange capability on all ranges.

BCD Output: 8421 code, 1 positive. TTL compatible logic.

66. DATA OUTPUT AND DIGITAL PANEL METER TEST (Cont'd.)

Control Lines (Outputs):

BCD Output as described above.

Overrange: Single bit indicates meter overrange.

Underrange: Single bit indicates meter underrange.

Range: Two bit code indicates range selected.

Print: Single bit indicates data is ready.

DESCRIPTION: The panel meter's digits and annunciator lamps are checked for proper operation. A digital printer is used to check the data output at J6.

EQUIPMENT:

Digital Recorder	HP 5055A
Interface Cable	HP 526-16C
Thermistor Mount	HP 478A or 8478B

PROCEDURE:

a. Set 432C MOUNT RESISTANCE to resistance shown on thermistor mount.

b. Connect the thermistor mount to the 432C (A2S1 should be set to OPERATE). Connect the digital printer to J6 on rear panel of 432C.

c. Set printer for positive 8421 BCD code and turn blanking on.

d. Set 432C RANGE to 1 mW.

e. Turn COARSE ZERO Screwdriver adjustment full ccw, then slowly turn it cw, checking the following:

1. The panel meter counts in sequence from < .000 mW to 1.199 mW.

2. The printer prints the same digits that appear on the meter (see Table 3 for an explanation of the print-out).

3. When the panel meter reads < .099 mW, the printer should print a "1" in the Underrange/Overrange column.

4. As the panel meter passes 1.199 mw, the display should blank, the "OR" lamp should light, and the printer should print a "2" in the Underrange/Overrange column.

f. Turn COARSE ZERO screwdriver adjustment ccw until the panel meter reads .000 mW. Set RANGE as follows, noting decimal point placement, μW and mW lamps, and the range code column on the print-out:

Range	Panel Meter	Range Code
10 μW	0.00 μW	0
100 μW	00.0 μW	1
1 mW	.000 mW	2
10 mW	0.00 mW	3

PERFORMANCE TESTS

66. DATA OUTPUT AND DIGITAL PANEL METER TEST (Cont'd.)

g. Set RANGE to AUTO; slowly turn COARSE ZERO to full cw. Each time the meter count passes 1199, the power meter should switch to the next higher range.

h. Slowly turn COARSE ZERO to full ccw. Each time the meter count passes 100, the power meter should switch to the next lower range.

67. DATA INPUT TEST

SPECIFICATIONS:

Control Lines (Inputs):

Remote Enable: Single bit establishes control of instrument ranging and fine zero controls for remote programming. Remote fine zero may be accomplished in remote or local modes of operation.

Remote Range: Two bit code selects instrument range.

Auto Zero: Contact closure to ground zeros meter.

Inhibit: Single bit holds data and stops A/D converter.

Ext. Trig.: When in inhibit mode, single bit starts data conversion. Data ready in 10 msec.

DESCRIPTION: The power meter's ability to be remotely controlled is checked using a remote control test set.

NOTE

If desired, six short wires, with test clips at each end, can be substituted for the test set. Shorting the appropriate pin (of J6) to ground provides a logical 0 input.

EQUIPMENT:

Remote Control Test Set	(See Figure 5)
Thermistor Mount	HP 478A or 8478B

PROCEDURE:

a. Set 432C MOUNT RESISTANCE to resistance shown on thermistor mount.

b. Connect the thermistor mount to the 432C (A2S1 should be set to OPERATE). Connect the test set to J6 on rear panel of 432C.

c. Set test set LOCAL/REMOTE to LOCAL and set AUTO ZERO to 1. Set 432C RANGE to COARSE ZERO and adjust COARSE ZERO screwdriver adjustment so that meter indicates zero.

d. Set 432C RANGE to AUTO and set AUTO ZERO to 0; the panel meter reading should go to zero.

e. Set test set as follows:

REMOTE/LOCAL	REMOTE
RANGE 2	1
RANGE 1	1
AUTO ZERO	1
INHIBIT	1
EXT TRIG.	1

67. DATA INPUT TEST (Cont'd.)

f. Depress 432C FINE ZERO switch; the panel meter reading should *not* attempt to go to zero. In turn, set 432C RANGE to 100 μW, 1 mW and 10 mW. The meter should *not* indicate that the power meter is changing ranges.

g. Set test set as follows. The panel meter should indicate that the 432C is changing ranges. (Note decimal point placement and μW and mW lamps.)

Range 2	Range 1	Panel Meter
0	0	0.00 μW
0	1	00.0 μW
1	0	.000 mW
1	1	0.00 mW

h. Set test set as follows:

RANGE 2 1
RANGE 1 0
INHIBIT 0

i. Turn COARSE ZERO screwdriver adjustment two turns cw. The panel meter reading should not respond (i.e. it should not increase).

j. Set test set EXT TRIG to 0. The panel meter reading should increase.

k. To assemble the remote control test set, obtain wire, SPST switches, mounting board or box, and connector (Cinch 57-30500-375). Assemble as shown in Figure 5.

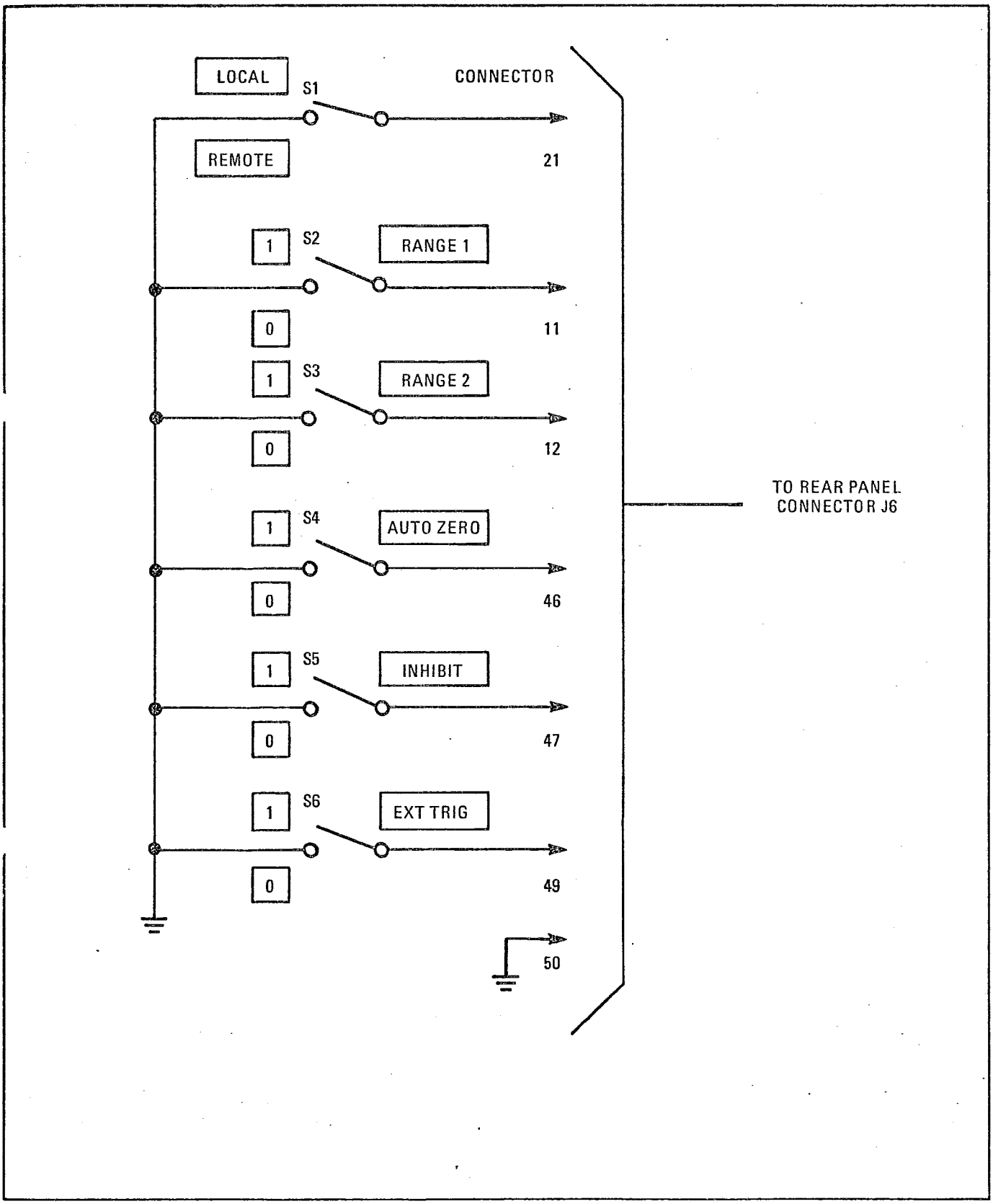


Figure 5. Remote Control Test Set

Table 7. Performance Test Record

Para. No.	Test Description	Measurement Unit	Min.	Actual	Max.
60	METER ACCURACY				
c.	Adjust ZERO knob	μW	−0.01	_____	+0.01
e.	DVM indication	mVdc	990	_____	1010
f.	432C indication	μW	9.90	_____	10.10
g.	Meter Accuracy, Table 4	μW	9.9	_____	10.1
		μW	99.5	_____	100.5
		mW	0.995	_____	1.005
		mW	9.95	_____	10.05
61	METER LINEARITY				
c.	432C indication	mW	0.95	_____	1.05
e.	432C indication	mW	1.95	_____	2.05
g.	432C indication	mW	2.95	_____	3.05
62	CALIBRATION FACTOR				
c.	Set ZERO knob	μW	99.9	_____	100.1
e.	432C indication	μW	98.4	_____	99.4
f.	Calibration Factor, Table 5	μW	99.9	_____	100.1
		μW	98.4	_____	99.4
		μW	97.3	_____	98.3
		μW	96.2	_____	97.2
		μW	95.2	_____	96.2
		μW	94.1	_____	95.1
		μW	93.0	_____	94.0
		μW	92.1	_____	93.1
		μW	91.1	_____	92.1
		μW	90.2	_____	91.2
		μW	89.2	_____	90.2
		μW	88.4	_____	89.4
		μW	87.5	_____	88.5
63	ZERO CARRYOVER				
d.	FINE ZERO down	μW	−0.01	_____	+0.01
e.	Zero Carryover, Table 6	μW	−0.5	_____	+0.5
		mW	−0.005	_____	+0.005
		mW	−0.05	_____	+0.05
64	FINE ZERO RANGE				
e.	Set COARSE ZERO	mW	0.299	_____	0.301
f.	FINE ZERO down	mW		_____	0.20
65	NOISE TEST				
d.	Peak to Peak Noise	mW		_____	5

68. ADJUSTMENTS

69. The following procedures supplement those documented in the 432A manual. (Disregard paragraph 5-35 in the manual.)

WARNING

Voltages potentially dangerous to life are present at the power supply transformer pins and at Digital Panel Meter M1 connectors.

70. Thermistor Bridge Assembly A1, Zero Adjustment

a. Remove the right side panel (see 432A manual, paragraph 5-27).

b. Connect a mount to the 432C and adjust COARSE ZERO.

c. Switch RANGE to 10 μW, push FINE ZERO down and adjust A1R43 for a zero indication on digital panel meter (adjust A1R43 until the "minus" lights — then back off until it just goes out).

d. Release FINE ZERO and replace the right side panel.

e. Perform the Zero Carryover Test in paragraph 88 of this supplement. If zero carryover is out of specification, perform the Digital Panel Meter Zero Adjustment, in paragraph 73, and repeat steps a. through d.

71. Auto Range Assembly A6 Power Supply Adjustment

a. Remove the top cover (see 432A manual paragraph 5-27).

b. Connect the DC digital voltmeter across A6 test points 2 and 3.

c. Apply line power to the 432C and adjust +5V ADJ A6R13 for 5.00 ±0.01 V.

d. Remove the digital voltmeter and replace the top cover.

72. Digital Panel Meter M1 Removal

a. Remove all power from the 432C; remove the top and side covers (see 432A manual, paragraph 5-27).

b. Disconnect the connectors from the back of the meter (XM1A and XM1B).

c. Remove the four top-front chassis screws that secure the digital panel meter bracket (see Figure 6).

d. Slide the digital panel meter up and back, exposing the two screws under the meter that secure the meter cover to the meter bracket; remove the screws.

e. Slide the top guide, securing the meter cover to the meter bracket, to the side and off.

f. Lift the meter cover and the filter and the mask from the front of the meter.

g. The meter can now be removed or adjusted.

h. For re-assembly, reverse the above procedures.

72. Digital Panel Meter M1 Removal (Cont'd.)

CAUTION

Be sure that Digital Panel Meter M1 is not installed upside-down. If power is applied to the 432C while the meter is installed upside-down, the meter will be damaged.

73. Digital Panel Meter Zero Adjustment

a. Remove the meter cover from the front of the meter and remove the A1 and A2 Assemblies (see steps a. through h. of paragraph 72).

b. Temporarily re-install the meter, leaving its readout exposed, in the chassis using two or more screws.

c. Check to insure that the connectors, XM1A and XM1B, are not reversed, that the meter is right side up and that XM1A and XM1B are not shorting to the chassis.

d. Short together XM1B pins 10 and 12.

e. Apply line power to the 432C.

f. Adjust the pot marked "Z", at the upper right hand corner of the digital panel meter face, for a zero indication on the meter.

WARNING

Use a non-metalic screwdriver and exercise caution; voltages potentially dangerous to life are present at the digital panel meter face, at connector XM1A and at the power supply transformer pins.

g. Remove the short at XM1B and re-assemble the 432C.

REPLACEABLE PARTS

Introduction

Table 9 is a list of replaceable parts for the The Thermistor Bridge Assembly A1, the Logic Assembly A2 and the Calibration Assembly A4 are the same for both the and 432C; refer to the 432A manual parts a parts breakdown of those assemblies.

Table 9 lists parts in alpha-numerical order of reference designation and provides the following information on each part:

a. HP Part Number.

b. Description (see abbreviations, Table 8).

c. Total Quantity used in instrument.

d. Manufacturer of the part in a five-digit code (see list of manufacturers in Table 10).

e. Manufacturers part number.

78. Ordering Information

79. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office (see list at rear of 432A manual for addresses). Identify parts by their Hewlett-Packard stock numbers.

80. To obtain a part that is not listed, include:

a. Instrument model number.

b. Complete instrument serial number.

c. Description of the part.

d. Function and location of the part.

Table 8. Reference Designations

REFERENCE DESIGNATORS

	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
	= motor	FL	= Filter	Q	= transistor		
	= battery	J	= jack	R	= resistor		
	= capacitor	K	= relay	RT	= thermistor	VR	= voltage regulator
	= coupler	L	= inductor	S	= switch		
	= diode	LS	= loud speaker	T	= transformer	W	= cable
	= delay line	M	= meter	TB	= terminal board	X	= socket
	= device signaling (lamp)	MK	= microphone	TP	= test point	Y	= crystal
	= misc electronic part	MP	= mechanical part	U	= integrated circuit	Z	= tuned cavity, network

ABBREVIATIONS

	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
	= amplifier	HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
	= beat frequency oscillator	HG	= mercury			S-B	= slow-blow
	= beryllium copper	HR	= hour(s)			SCR	= screw
	= binder head	Hz	= Hertz	NPN	= negative-positive-negative	SE	= selenium
	= bandpass	IF	= intermediate freq			SECT	= section(s)
	= brass	IMPG	= impregnated	NRFR	= not recommended for field replacement	SEMICON	= semiconductor
	= backward wave oscillator	INCD	= incandescent			SI	= silicon
	= counterclockwise	INCL	= include(s)	NSR	= not separately replaceable	SIL	= silver
	= ceramic	INS	= insulation(ed)			SL	= slide
	= cabinet mount only	INT	= internal	OBD	= order by description	SPG	= spring
	= coefficient	K	= kilo = 1000			SPL	= special
	= common	LH	= left hand	OH	= oval head	SST	= Stainless steel
	= composition	LIN	= linear taper	OX	= oxide	SR	= split ring
	= complete	LK WASH	= lock washer			STL	= steel
	= connector	LOG	= logarithmic taper	P	= peak	TA	= tantalum
	= cadmium plate	LPF	= low pass filter	PC	= printed circuit	TD	= time delay
	= cathode-ray tube	M	= milli = 10^{-3}	PF	= picofarads = 10^{-12} farads	TGL	= toggle
	= clockwise	MEG	= meg = 10^{6}	PH BRZ	= phosphor bronze	THD	= thread
	= deposited carbon	MET FLM	= metal film	PHL	= Phillips	TI	= titanium
	= drive	MET OX	= metallic oxide	PIV	= peak inverse voltage	TOL	= tolerance
	= electrolytic	MFR	= manufacturer	PNP	= positive-negative-positive	TRIM	= trimmer
	= encapsulated	MHz	= mega Hertz	P/O	= part of	TWT	= traveling wave tube
	= external	MINAT	= miniature	POLY	= polystrene	μ	= micro = 10^{-6}
	= farads	MOM	= momentary	PORC	= porcelain		
	= flat head	MOS	= metalized substrate	POS	= position(s)	VAR	= variable
	= Fillister head	MTG	= mounting	POT	= potentiometer	VDCW	= dc working volts
	= fixed	MY	= "mylar"	PP	= peak-to-peak		
	= giga (10^{9})	N	= nano (10^{-9})	PT	= point	W/	= with
	= germanium	N/C	= normally closed	PWV	= peak working voltage	W	= watts
	= glass	NE	= neon	RECT	= rectifier	WIV	= working inverse voltage
	= ground(ed)	NI PL	= nickel plate	RF	= radio frequency	WW	= wirewound
				RH	= round head or right hand	W/O	= without

Table 9. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	00432-60024	1	BOARD ASSY:BRIDGE	28480	00432-60024
A2	00432-6015	1	BOARD ASSY:LOGIC	28480	00432-6015
A3			NOT ASSIGNED		
A4	00432-6004	1	SWITCH ASSY:CALIBRATION FACTOR	28480	00432-6004
A5			NOT ASSIGNED		
A6	00432-60201	1	BOARD ASSY:AUTO RANGE	28480	00432-60201
A6C1	0160-3460	2	C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023E101L503ZS22-CDH
A6C2	0160-3460		C:FXD CER 0.05 UF +80-20% 100VDCW	56289	C023E101L503ZS22-CDH
A6C3	0180-0229	1	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229
A6C4	0180-2100	1	C:FXD ELECT 1200UF +75-10% 15VDCW	56289	39D128G015FL4-DSB
A6C5	0160-3533	1	C:FXD MICA 470 PF 5% 100VDCW	00853	RDM15F471J1C
A6C6	0180-2206	1	C:FXD ELECT 60 UF 10% 6VDCW	56289	150D606X900682
A6C7	0160-2055	1	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A6CR1	1901-0159	2	DIODE:SILICON 0.75A 400PIV	04713	SR1358-4
A6CR2	1901-0159		DIODE:SILICON 0.75A 400PIV	04713	SR1358-4
A6E1	00432-60202	1	JUMPER	28480	00432-60202
A6K1	0490-0916	6	RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6K2	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6K3	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6K4	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6K5	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6K6	0490-0916		RELAY:REED 1 FORM A 0.5 AMP	15636	RA30231051
A6Q1	1854-0022	3	TSTR:SI NPN	07263	S17843
A6Q2	1854-0022		TSTR:SI NPN	07263	S17843
A6Q3	1854-0022		TSTR:SI NPN	07263	S17843
A6Q4	1854-0071	2	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q5	1853-0020	1	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A6Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6R1	0757-0401	1	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
A6R2	0757-0442	2	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R3	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A6R4	0698-3160	8	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R5	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R6	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R7	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R8	0811-2536	1	R:FXD WW 3167 OHM 0.1% 1/40W	28480	0811-2536
A6R9	0811-2284	1	R:FXD WW 1K OHM 0.1% 1/40W	28480	0811-2284
A6R10	0811-2534	1	R:FXD WW 314.3 OHM 0.1% 1/40W	28480	0811-2534
A6R11	0811-2535	1	R:FXD WW 145.0 OHM 0.1% 1/40W	28480	0811-2535
A6R12	0757-0420	1	R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420
A6R13	2100-2574	1	R:VAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2574
A6R14	0698-0085	1	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
A6R15	0811-2815	1	R:FXD WW 1.5 OHM 5% 1/2W	28480	0811-2815
A6R16	0757-0280	2	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A6R17	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R18	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R19	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R20	0698-3160		R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160
A6R21	0757-0279	1	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A6U1	1820-0196	1	IC:LINEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A6U2	1820-0328	1	IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A6U3	1820-0054	1	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A6U4	1820-0084	1	IC:TTL 4W 2-INPT AND/OR GATE	01295	SN7453N
A6U5	1820-0535	1	IC:TTL DUAL 2-INPT DRIVER(OPEN COLL)	01295	SN75451
A6U6	1820-0382	1	IC:TTL HS 2 W 4-INPT AND OR INV GATE	01295	SN74H55N
A6U7	1820-0174	1	IC:TTL HEX INVERTER	01295	SN7404N
A6U8	1820-0261	1	IC:TTL MONO-STABLE MULTIVIBRATOR	01295	SN74121N
A6U9	1820-0063	1	IC:TTL DUAL 2W 2-INPT AND OR INV GATE	04713	SN7451N
A6U10	1820-0774	1	IC:TTL TRIPLE 3-INPT OR GATE	28480	1820-0774
A6U11	1820-0076	1	IC:TTL DUAL J-K F/F W/PRESET CLOCK	01295	SN7476N
			CHASSIS PARTS		
A0					
C1	0160-3043	1	C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
C2			NOT ASSIGNED(STANDARD INSTRUMENT		
C3	0160-2438	3	C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-061-X5V0-502P
C4	0160-2438		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-061-X5V0-502P
C5	0160-2438		C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-061-X5V0-502P
DS1	2140-0244	1	LAMP:GLOW MINIATURE 95V	87034	A1H
DS2	2140-0016	2	LAMP:INCANDESCENT 5.0V 0.06A	71744	683
DS3	2140-0016		LAMP:INCANDESCENT 5.0V 0.06A	71744	683
F1	2110-0201	1	FUSE:0.25A 250V SLO-BLO	71400	MDL-1/4
F1			(FOR 115V OPERATION)		
F1	2110-0318	1	FUSE:0.125 AMP SLOW-BLOW	71400	MDL 108
F1			(FOR 230V OPERATION)		
J1	1251-1280	1	CONNECTOR:AUDIO 6 FEMALE CONTACTS	28480	1251-1280
J1	00432-2005	1	NUT:CONNECTOR	28480	00432-2005

See introduction to this section for ordering information

Table 9. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
J2	1250-0118	3	CONNECTOR:BNC	24931	28JP 128-1
J2	5040-0702	6	INSULATOR:CONNECTOR	28480	5040-0702
J3	1250-0118		CONNECTOR:BNC	24931	28JR 128-1
J3	5040-0702		INSULATOR:CONNECTOR	28480	5040-0702
J4	1250-0118		CONNECTOR:BNC	24931	28JR 128-1
J4	5040-0702		INSULATOR:CONNECTOR	28480	5040-0702
J5	1251-2357	1	SOCKET:3-PIN MALE POWER RECEPTACLE	82389	EAC-301
J5			(PART OF REAR PANEL)		
J6	1251-0087	1	CONNECTOR:FEMALE 50-PIN MINAT	28480	1251-0087
M1	1120-1526	1	METER:DIGITAL	28480	1120-1526
M1			(EXCHANGE MODULE)		
M1	1120-1542	1	METER:DIGITAL	28480	1120-1542
MP1	0370-0077	1	KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT	28480	0370-0077
MP1			(RANGE)		
MP2	0370-0193	1	KNOB:ROTARY POINTER BLACK	28480	0370-0193
MP2			(CAL FACTOR)		
MP3	0370-0432	1	KNOB:BLACK LEVER	28480	0370-0432
MP3			(MT. RES.)		
MP4	0590-0500	4	NUT:HEX CAP #6-32 THREAD	73734	74101
MP4	00432-00107	1	COVER:TRANSFORMER	28480	00432-00107
MP5	5020-7633	1	METER TRIM:THIRD MODULE	28480	5020-7633
MP6			NOT ASSIGNED		
MP7			NOT ASSIGNED		
MP8	00432-00103	1	DECK:LOWER	28480	00432-00103
MP9	00432-00104	1	BRACKET:BOARD	28480	00432-00104
MP10	00432-00105	1	BRACKET:READOUT	28480	00432-00105
MP11	00432-00106	2	GUIDE:BOARD	28480	00432-00106
MP12			NOT ASSIGNED		
MP13	00432-00108	1	MASK:DPM	28480	00432-00108
MP14	00432-20102	2	GUIDE:EXTRUSION	28480	00432-20102
MP15	00432-20104	1	FILTER:DPM	28480	00432-20104
MP16	1120-1550	1	METER CASE:FRONT HALF	28480	1120-1550
MP17	0340-0008	3	INSULATOR:STANDOFF TEFLON	98291	ST-1000-L2
MP18	00432-40101	1	SPACER	28480	00432-40101
Q1	1854-0072	1	TSTR:SI NPN	80131	2N3054
R1	2100-2849	1	R:VAR WW 50K OHM 3% LIN 2W	28480	2100-2849
R1	2950-0034	1	NUT:HEX BRASS 3/8-32 X 1/2"	28480	2950-0034
R1	00432-2004	1	BUSHING:PANEL	28480	00432-2004
R2	0811-2538	4	R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
R3	0811-2538		R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
R4	0811-2538		R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
R5	0811-2538		R:FXD WW 100 OHM 0.1% 1/10W	28480	0811-2538
R6	0757-0984	2	R:FXD MET FLM 10.0 OHM 1% 1/2W	28480	0757-0984
R7	0757-0984		R:FXD MET FLM 10.0 OHM 1% 1/2W	28480	0757-0984
R8	0757-0198	1	R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
R9	0757-0458	1	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R10			NOT ASSIGNED(STANDARD INSTRUMENT		
R13			NOT ASSIGNED(STANDARD INSTRUMENT		
R14	0811-2277	1	R:FXD WW 10K OHM 0.1% 1/40W	28480	0811-2277
R15	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
S1	3101-1248	1	SWITCH:PUSHBUTTON SPDT ILLUMINATED	87034	53-55480-121/A1H
S1			(POWER)		
S2	3101-1234	1	SWITCH:SLIDE DPDT	82389	11A-1242
S2			(PART OF REAR PANEL)		
S3	3100-2485	1	SWITCH:LEVER SINGLE SECTION	76854	TYPE 184
S3			(MT. RES.)		
S3	00432-00031	2	SWITCH PLATE	28480	00432-00031
S4	3101-1357	1	SWITCH:TOGGLE SPDT	09353	7109
S4			(FINE ZERO)		
S4	00432-2003	1	NUT:DRESS	28480	00432-2003
S5	3100-3029	1	SWITCH:ROTARY 1 SECTION 6 POSITION	28480	3100-3029
T1	9100-3155	1	TRANSFORMER:POWER	28480	9100-3155
W1	8120-1082	1	CABLE ASSY:5 FT	28480	8120-1082
W2	8120-1348	1	CABLE ASSY:POWER, DETACHABLE	70903	KHS-7041
W3	00432-6010	1	CABLE ASSY:POWER SWITCH	28480	00432-6010
W4	00432-60102	1	CABLE ASSY:BCD	28480	00432-60102
XA1	1251-0172	2	CONNECTOR:PC EDGE 1 ROW 22 CONTACT	71785	250-22-30-210
XA1			(PART OF LOWER DECK)		
XA2	1251-0172		CONNECTOR:PC EDGE 1 ROW 22 CONTACT	71785	250-22-30-210
XA2			(PART OF LOWER DECK)		
XA6	1251-0233	1	CONNECTOR:PC EDGE (2 X 11) 22 CONTACT	71785	251-22-30-261
XF1	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
XM1	1251-0159	2	CONNECTOR:PC EDGE 2 X 15 CONTACT	71785	251-15-30-261
XM1	1251-0159		CONNECTOR:PC EDGE 2 X 15 CONTACT	71785	251-15-30-261
XM1	1251-1115	2	KEY:POLARIZING FOR CKT BD SOCKETS	71785	456-99-99-193

Table 9. Replaceable Parts (Cont'd.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
XM1	1251-1115		KEY:POLARIZING FOR CKT BD SOCKETS	71785	456-99-99-193
XQ1	0340-0162	1	INSULATOR:TSTR FOR TO-66	13103	A0340-0162-1
XQ1	1200-0168	1	SOCKET:TRANSISTOR	28480	1200-0168
Z2	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
Z3	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
Z4	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
Z5	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38
Z6	9170-0016		BEAD:MAGNETIC SHIELDING	02114	56-590-65/38

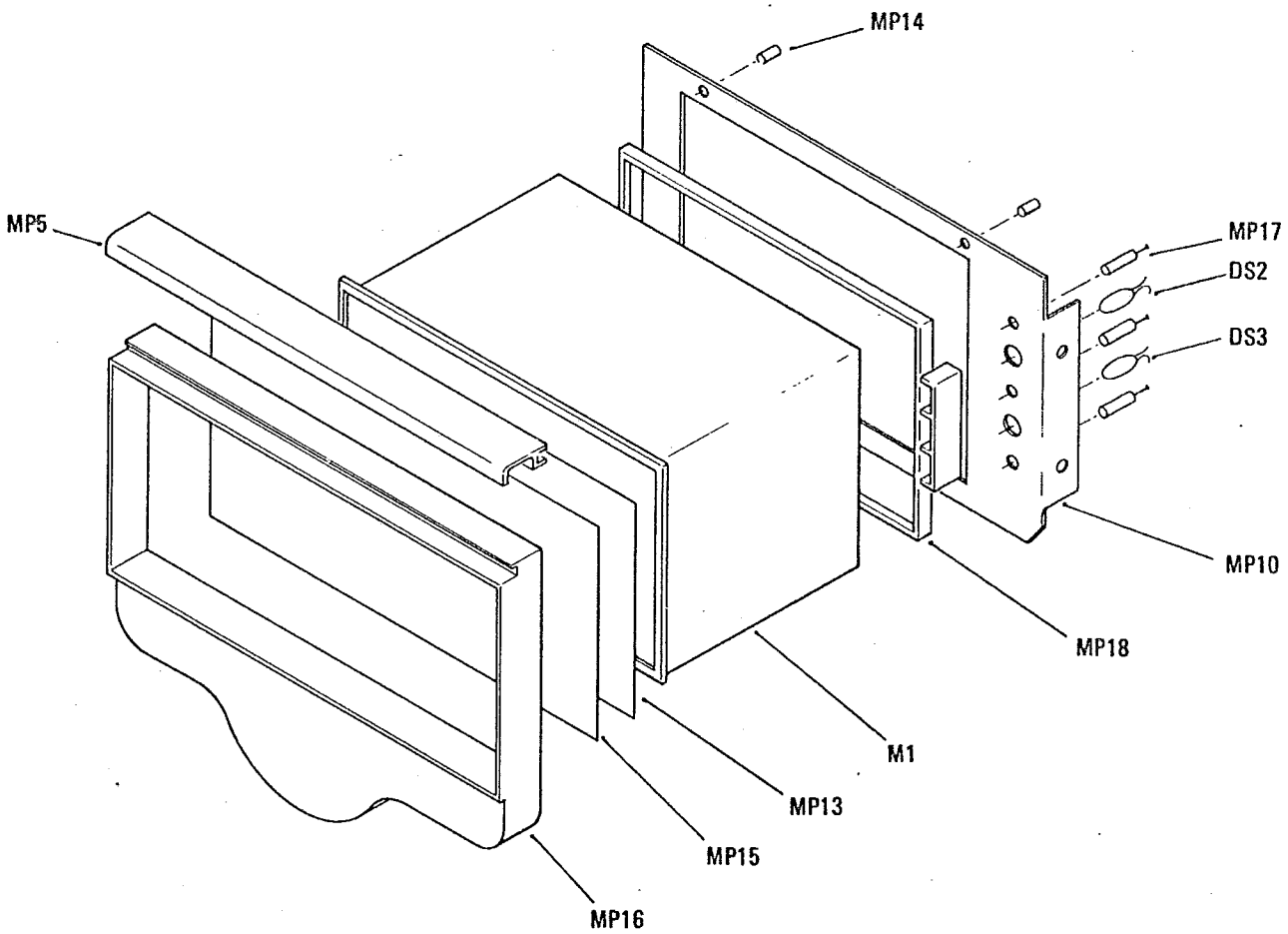


Figure 6. Panel Meter Components, Exploded View

Table 9. Replaceable Parts (Cont'd.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
0			CABINET PARTS		
1	5060-0703	2	FRAME ASSY:6 X 11 SM	28480	5060-0703
2	1490-0031	1	STAND:TILT	28480	1490-0031
3	5040-0700	2	HINGE	28480	5040-0700
4	5060-0727	2	FOOT ASSY	28480	5060-0727
5			NOT ASSIGNED		
6	5000-8565	2	COVER:SIDE	28480	5000-8565
7	5060-8555	1	COVER ASSY:TOP 5 X 11	28480	5060-8555
8	5000-8571	1	COVER:BOTTOM 5 X 11	28480	5000-8571
9	00432-00109	1	PANEL:REAR	28480	00432-00109
10	00432-00201	1	PANEL:FRONT	28480	00432-00201
11	00432-0011	1	BRACKET:FRAME	28480	00432-0011

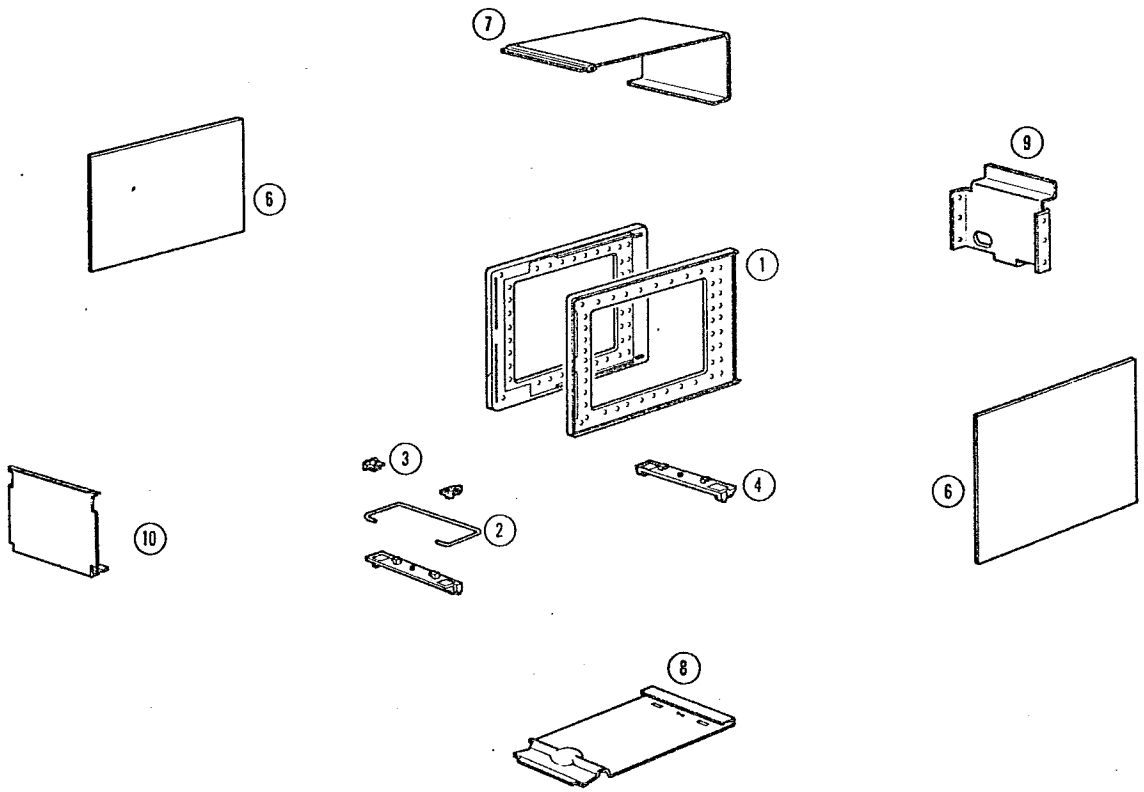


Figure 7. Chassis Parts, Exploded View

Table 10. Code List of Manufacturers

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00853	SANGAMO ELECTRIC CO.PICKENS DIV.	PICKENS, S.C.	29671
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02114	FERROXCUBE CORP.	SAUGERTIES, N.Y.	12477
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
09353	C & K COMPONENTS INC.	NEWTON, MASS.	02158
13103	THERMALLOY CO.	DALLAS, TEX.	75247
15636	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
24931	SPECIALTY CONNECTOR CO. INC.	INDIANAPOLIS, IND.	46227
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.	94304
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGO, ILL.	60640
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
73734	FEDERAL SCREW PROD. INC.	CHICAGO, ILL.	60618
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
76854	OAK MFG. CO. DIV. OAK ELECTRO/NETICS CORP.	CRYSTAL LAKE, ILL.	60014
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
87034	MARCOAK INDUSTRIES	ANAHEIM, CALIF.	92803
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544

81. TROUBLESHOOTING, SCHEMATICS, AND COMPONENT LOCATIONS

82. Introduction

83. All of the troubleshooting information and component locations for the Thermistor Bridge Assembly A1, Meter Logic Assembly A2, and Calibration Factor Switch Assembly A4 is the same in both the 432A and 432C; this information is contained in the 432A manual.

NOTE

A 22 pin extender board (HP 5060-0630) is required to perform component level troubleshooting and repair on Auto Range Assembly A6.

84. Meter Exchange Information

85. Digital panel meters for the 432C are not field repairable. They are available from Hewlett Packard, on an exchange basis, at a considerable savings in cost. Simply contact the Hewlett Packard office nearest you and make your requirements known. The local Hewlett Packard office will arrange for immediate airmail shipment to minimize equipment downtime. At least 90% of the orders for exchange modules received by an HP Field Sales Office will be shipped the same day — either from the sales office itself or from a service center.

86. When a digital panel meter is found to be defective use the "Exchange Module" part number, listed under its reference designator in Table 9, to order an exchange meter. Upon receiving the exchange meter, the defective meter should be returned in the same special carton in which the exchange meter was received. Use the procedures in paragraph 72 to remove and replace the digital panel meter.

87. Troubleshooting

88. Digital Panel Meter M1. If the panel meter will not zero, or if zero carryover is out of specification, the trouble can be isolated as follows:

a. Remove Meter Logic Assembly A2.

b. Short together XA2 pins 10 and 12 (or XM1B pins 5 and 7).

c. The panel meter should read zero ± one digit.

d. If the meter is out of specification, perform the Digital Panel Meter Zero Adjustment procedure in paragraph 73 of this supplement.

89. The Meter Accuracy Test in paragraph 60 will also isolate trouble to the panel meter. Correct RECORDER output readings and incorrect panel meter readings would indicate that the trouble is in the panel meter.

90. Some of the data inputs and outputs at connector J6 connect directly to the panel meter. If either the Data Output And Digital Panel Meter Test or the Data Input Test (located in paragraphs 66 and 67) indicate trouble, examine Service Sheets 4 and 5 to isolate trouble to the meter or Auto Range Assembly A6.

91. If the meter is found to be defective, do not attempt to open the meter's case or otherwise repair it. To do so would void the meter's warranty. Instead, exchange it following the procedures outlined under paragraph 84.

92. Auto Range Assembly A6. Isolate trouble to the A6 assembly using the Data Output And Digital Panel Meter Test and the Data Input Test (located in paragraphs 66 and 67). Note the specific trouble, then examine Service Sheets 4 and 5 to isolate the trouble to the A6 assembly or the panel meter. For example, an inability to auto range would probably be caused by the A6 assembly; trouble with the Inhibit input would be caused by the panel meter.

93. When trouble has been isolated to the A6 assembly, remove the top cover from the 432C (see 432A manual paragraph 5-27). Remove the A6 assembly and re-install it on an extender board (HP 5060-0630).

94. To check the +5V power supply (A6U1 and associated components), connect a digital voltmeter across A6 test points 2 and 3. The voltmeter should read +5.00 ± 0.01 V. If the voltage is high, adjust A6R13. If the voltage is low, check that the voltage drop across A6R15 does not exceed 600 mV. If it does, some component external to the power supply is probably drawing too much current. If the voltage drop is less than 600 mV, check Q1, the 10 Vrms input, and the +7V reference voltage at A6U1 pin 4.

95. To check the range code from the up/down counter, the decoder drivers, the relays, and the lamps on the front panel, set RANGE as shown in Table 11 and use a digital voltmeter to check the designated points (see Service Sheet 5).

NOTE

A logical 1 equals +3.5V ± 1V and a logical 0 equals 0.2V ± 0.2V.

Table 11. Up/Down Counter and Decoder Driver Troubleshooting

Range	Range Code				Decimal Point			Lamp		Relays Energized*
	R_2 (U3-2)	R_1 (U3-1)	R_2 (U3-9)	R_1 (U3-10)	1 (right)	2 (cent.)	3 (left)	μW	mW	
10 μW	0	0	1	1	OFF	ON	OFF	ON	OFF	K2 and K5
100 μW	0	1	1	0	ON	OFF	OFF	ON	OFF	K4 and K5
1 mW	1	0	0	1	OFF	OFF	ON	OFF	ON	K6 and K3
10 mW	1	1	0	0	OFF	ON	OFF	OFF	ON	K6 and K1

*All Others De-energized

96. If the Data Output And Digital Panel Meter Test (in paragraph 66) indicates that the 432C will not auto range up and/or down (and the Underrange and Overrange Flags are correct) check A6U4, U6, U11 and U7. Use the procedures in the test (steps a. — e.) to set the conditions shown in Table 12; check J/K_1 and J/K_2.

NOTE

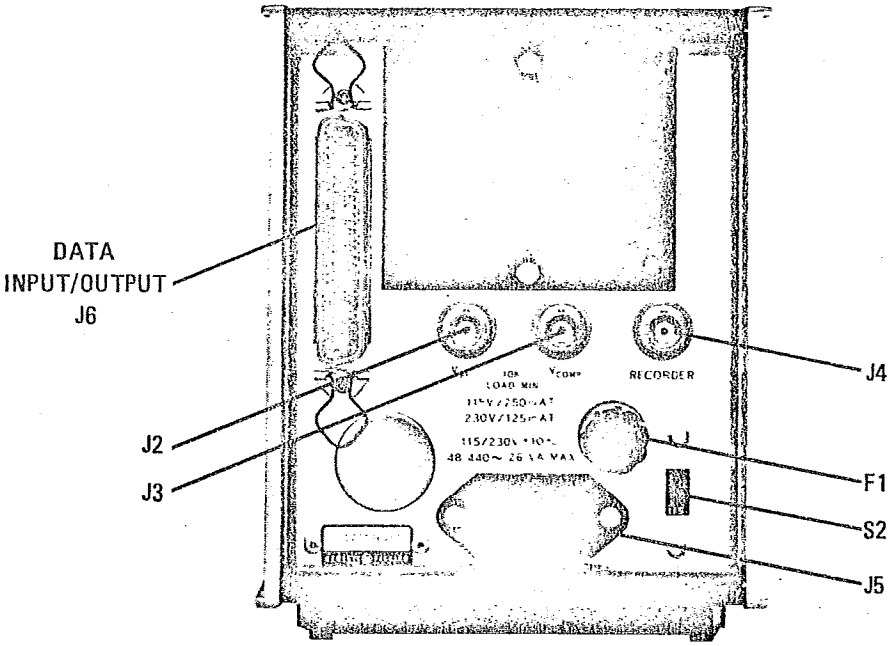
If J/K_1 and J/K_2 are correct and the meter will not auto range up or down, check for the positive Clock pulses (one about every 500 msec) at A6U11 pins 1 and 6. If the clock pulses are correct, U11 is probably defective.

Table 12. Auto Range Troubleshooting

Range	Condition	J/K_2*	J/K_1*
10 μW	Underrange	0	0
	Overrange	0	1
100 μW	Underrange	0	1
	Overrange	1	1
1 mW	Underrange	1	1
	Overrange	0	1
10 mW	Underrange	0	1
	Overrange	0	0

*Check J/K_2 at U7–10, check J/K_1 at U7–12

REAR VIEW



TOP VIEW

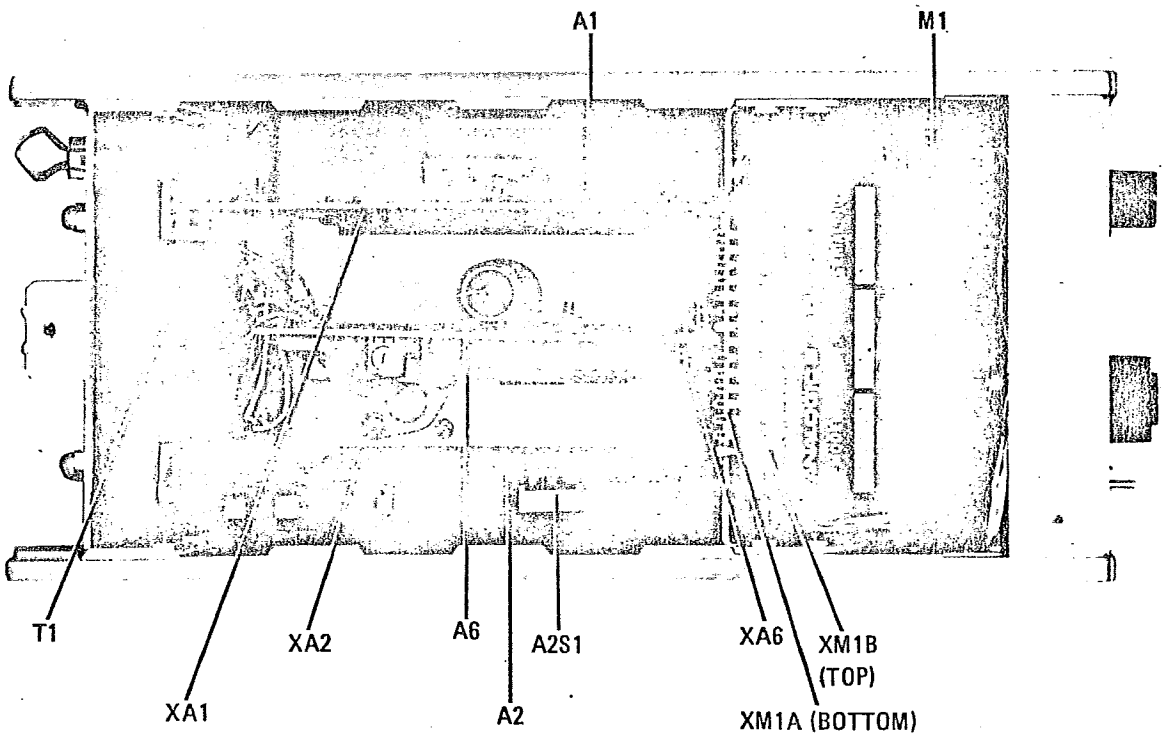


Figure 8. Assembly and Component Locations

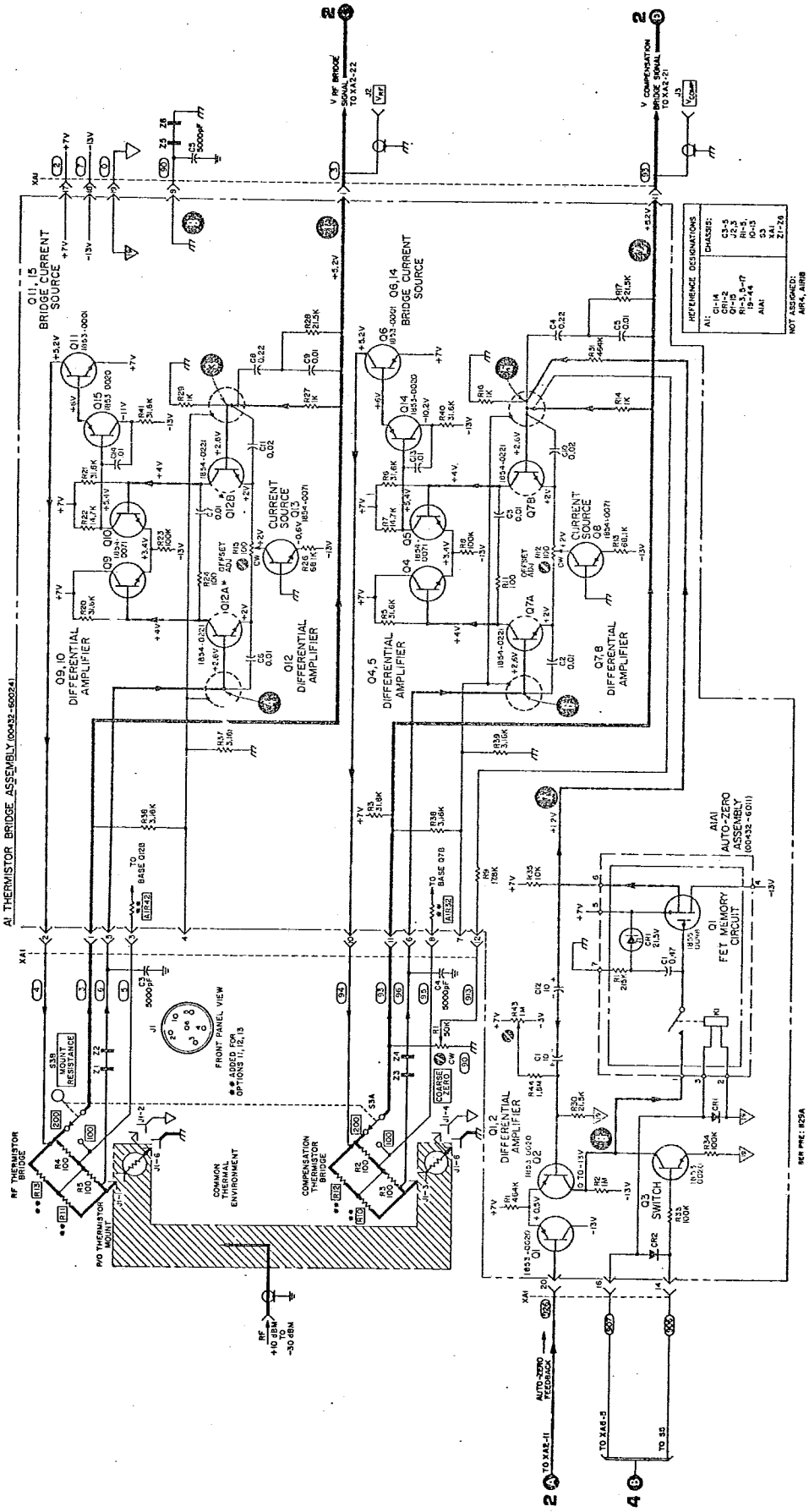


Figure 9. RF and Compensation Bridge Schematic

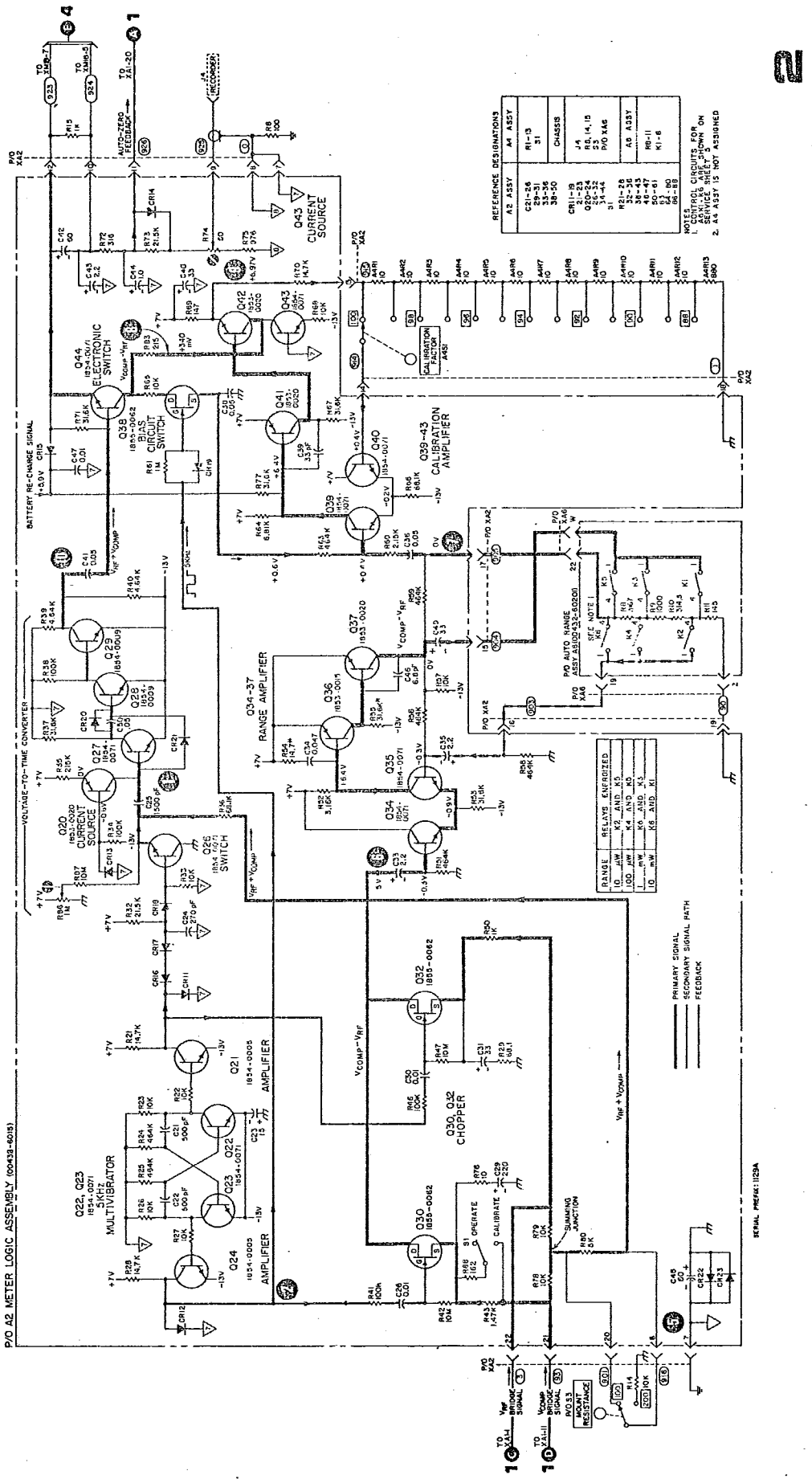


Figure 10. Meter Logic Schematic

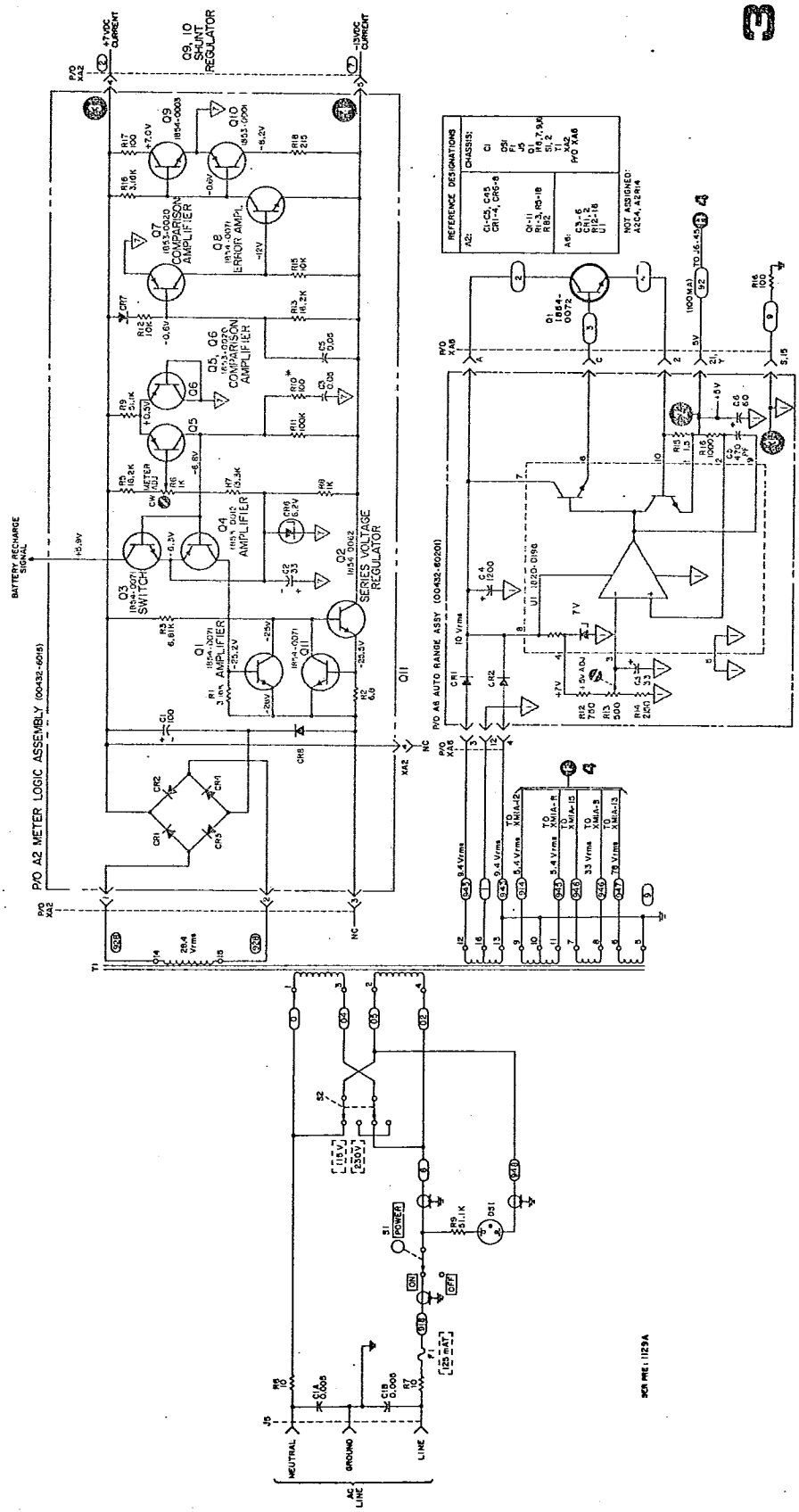


Figure 11. Power Supply Schematic

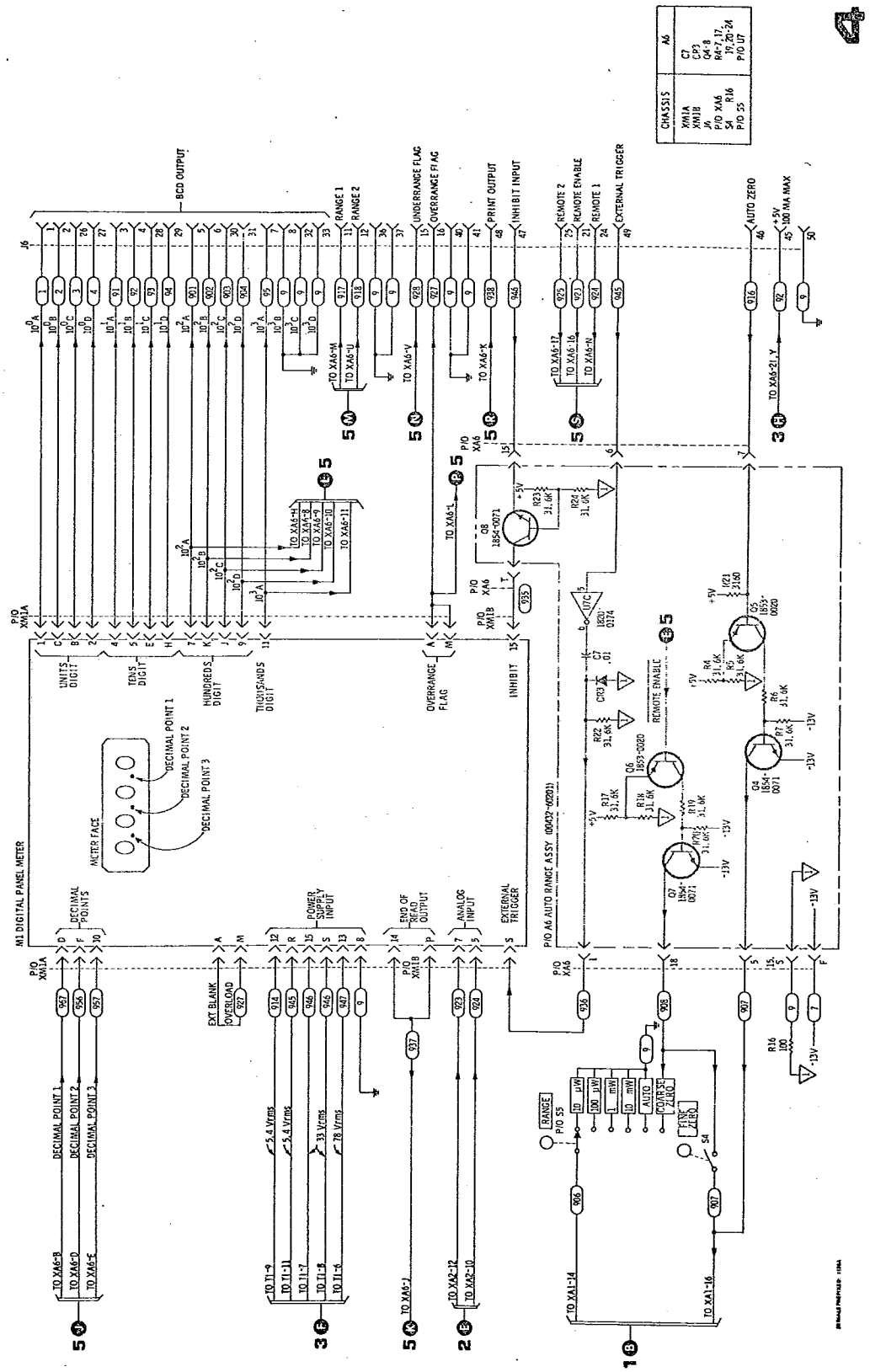


Figure 12. Digital Panel Meter M1 and Connector J6 Interconnections

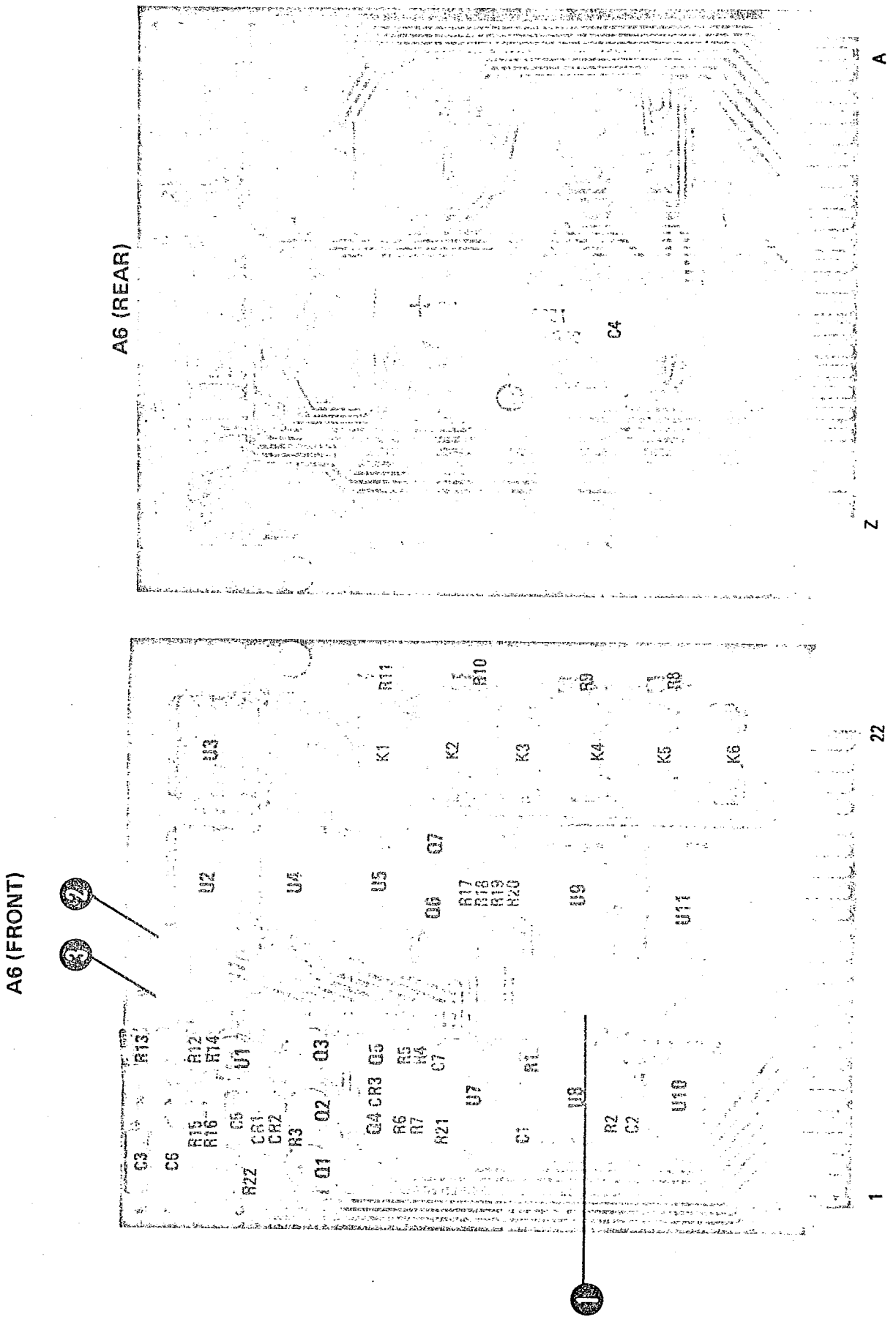


Figure 13. Auto Range Assembly A6 Component Locations

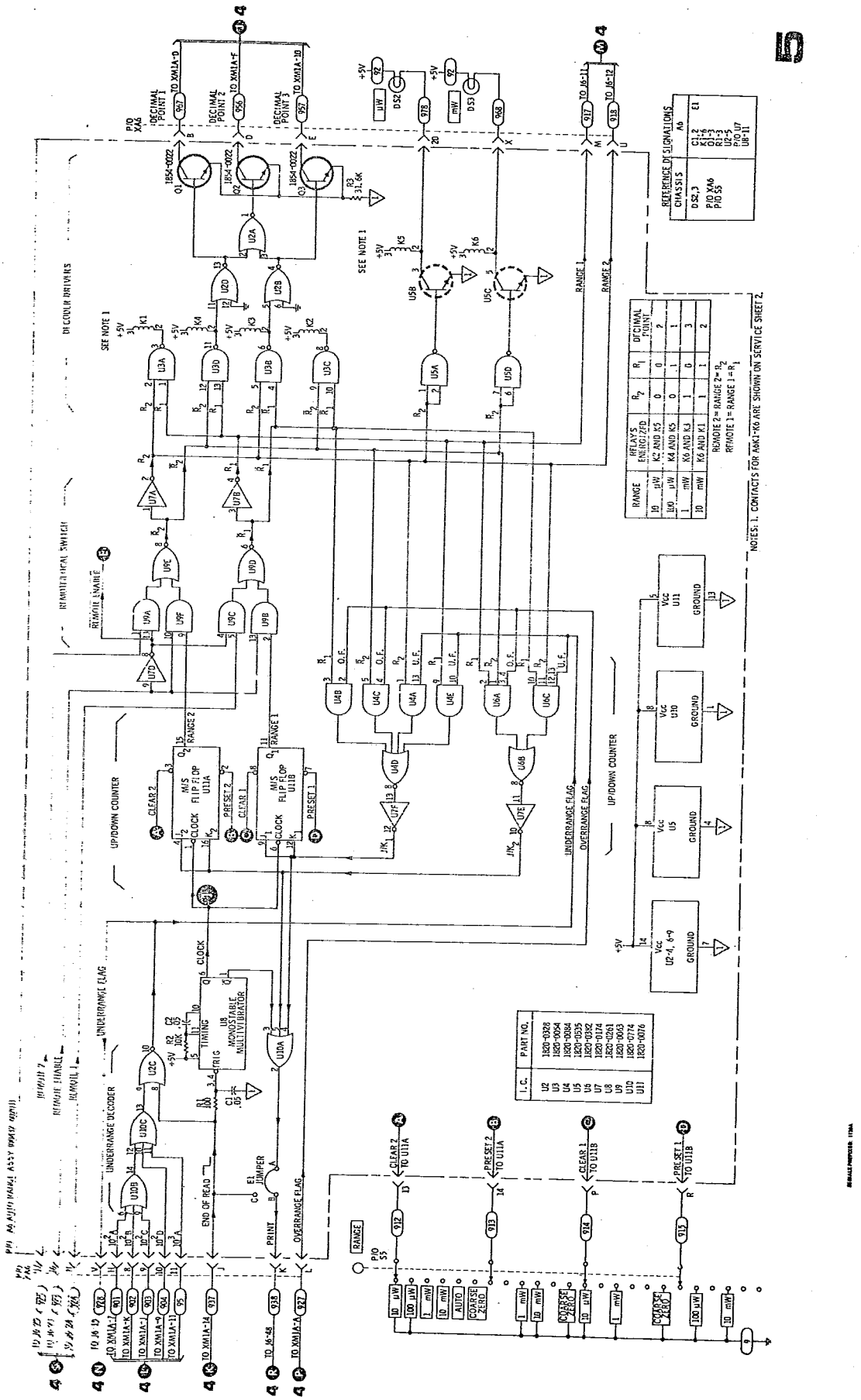


Figure 14. Auto Range Circuits

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT hp PACKARD

HP Part No. 00432-90027

PRINTED IN U.S.A.

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 432C
Date Printed: October 1971
Part Number: 00432-90027

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
1213A00140 to 00230	1
1213A00231 to 00250	1, 2
1249A00251 to 00300	1, 2

Serial Prefix or Number	Make Manual Changes
1249A00301 and above	1-3

▶ NEW ITEM

ERRATA

Page 4:
Under paragraph 17, add the following:

NOTE

The HP 1251-0086 plug (Amphenol and Cinch part number 57-30500-375) mates with data jack J6 on the rear panel.

Page 6, paragraph 30:
Change "HP 562-16C" to "HP 562A-16C".

Page 12, paragraph 58:
In "b", change "HP 562-16C" to "HP 562A-16C".

Page 14, paragraph 62:
In procedure step c, change "9.99" to "99.9".

Page 19, paragraph 67e:
Change "RANGE 2" to "REMOTE 2" and "RANGE 1" to "REMOTE 1."

Page 20, paragraphs 67g and 67h:
Change "RANGE 2" to "REMOTE 2" and "RANGE 1" to "REMOTE 1."

Page 21, Figure 5:
Change connector pins "11" to "24" and "12" to "25." Change "RANGE 1" to "REMOTE 1" and "RANGE 2" to "REMOTE 2".

Page 27, Table 9:
Change to read as follows:

J2	5040-0702 INSULATOR: CONNECTOR (LIGHT GRAY)
J2	5040-0345 INSULATOR: CONNECTOR (JADE GRAY)
J3	5040-0702 INSULATOR: CONNECTOR (LIGHT GRAY)

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

13 July 1973
5 Pages

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Printed in U.S.A.

ERRATA (cont'd)

Page 27, Table 9 (cont'd):

J3	5040-0345	INSULATOR: CONNECTOR (JADE GRAY)
J4	5040-0702	INSULATOR: CONNECTOR (LIGHT GRAY)
J4	5040-0345	INSULATOR: CONNECTOR (JADE GRAY)
MP16	1120-1543	METER CASE (LIGHT GRAY)
MP16	1120-1550	METER CASE (JADE GRAY)

Change MP8 part number to 00432-00112.

Page 35, Figure 10, Service Sheet 2:
Replace with attached schematic.

Page 36, Figure 11, Service Sheet 3:
Remove ground connection to T1 pin 13.

Page 37, Figure 12, Service Sheet 4:
Change XM1B pins "7" to "H" and "5" to "E".

Page 38, Figure 13:
Change integrated circuit marked "U5" to "U6" and add "U5" to unlabeled circuit under U3.

Page 39, Figure 14, Service Sheet 5:
Change color code of wire coded 914 (at XA6-P) to 4; change code of wire coded 915 (at XA6-R) to 5.

CHANGE 1

Page 26, Table 9:
Add the following:

C6	0160-3451	C: FXD CER 0.01 UF +80—20% 100 VDCW

Page 37, Figure 12, Service Sheet 4:
Replace with attached schematic.

CHANGE 2

Page 39, Figure 14:
Replace with attached schematic.

CHANGE 3

Page 27, Table 9:

Delete	MP16	1120-1543	METER CASE (LIGHT GRAY).
Delete	MP16	1120-1550	METER CASE (JADE GRAY).
Add	MP16	1120-0268	METER CASE.

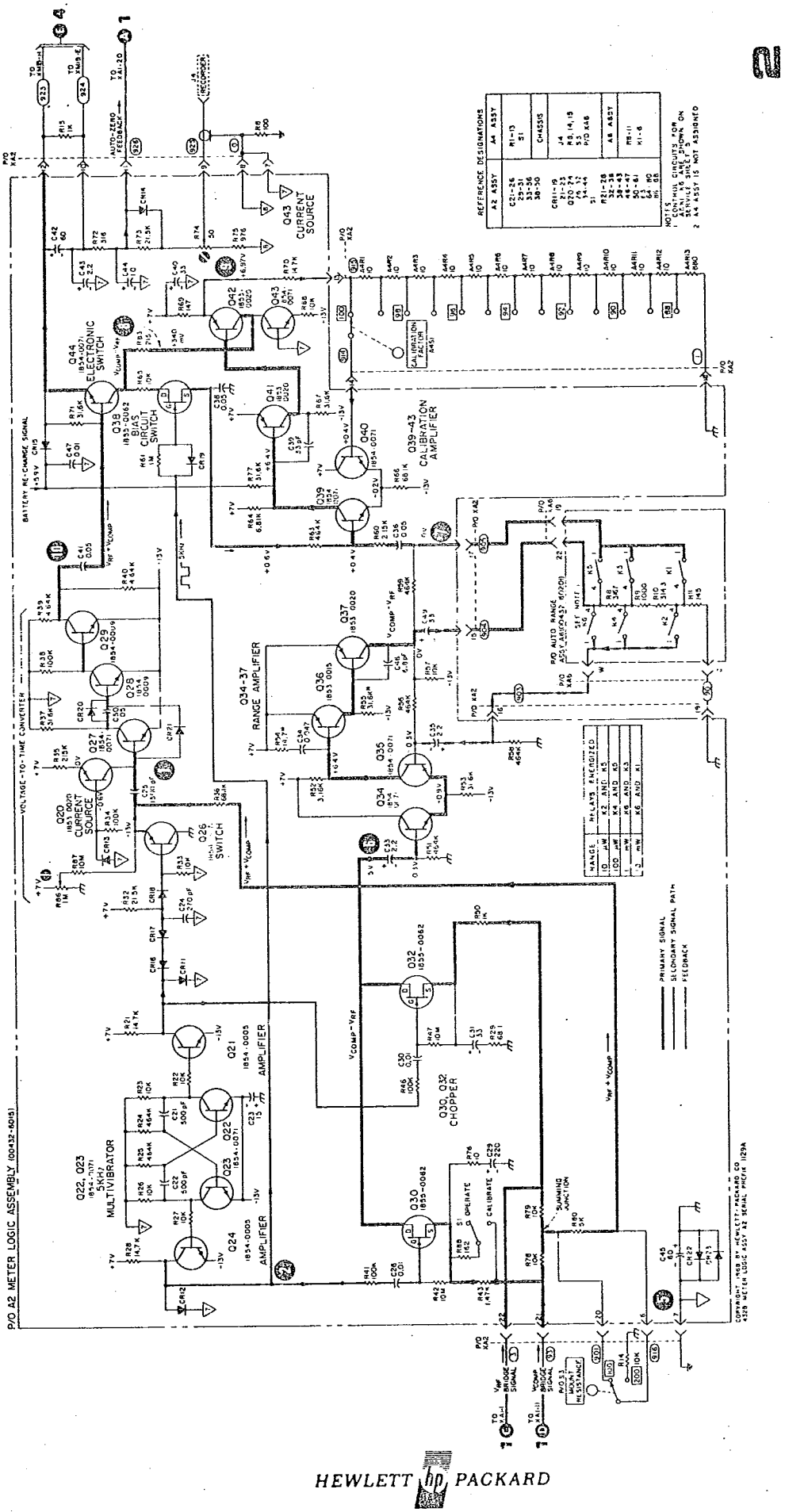


Figure 10. Meter Logic Schematic (Part of Errata)

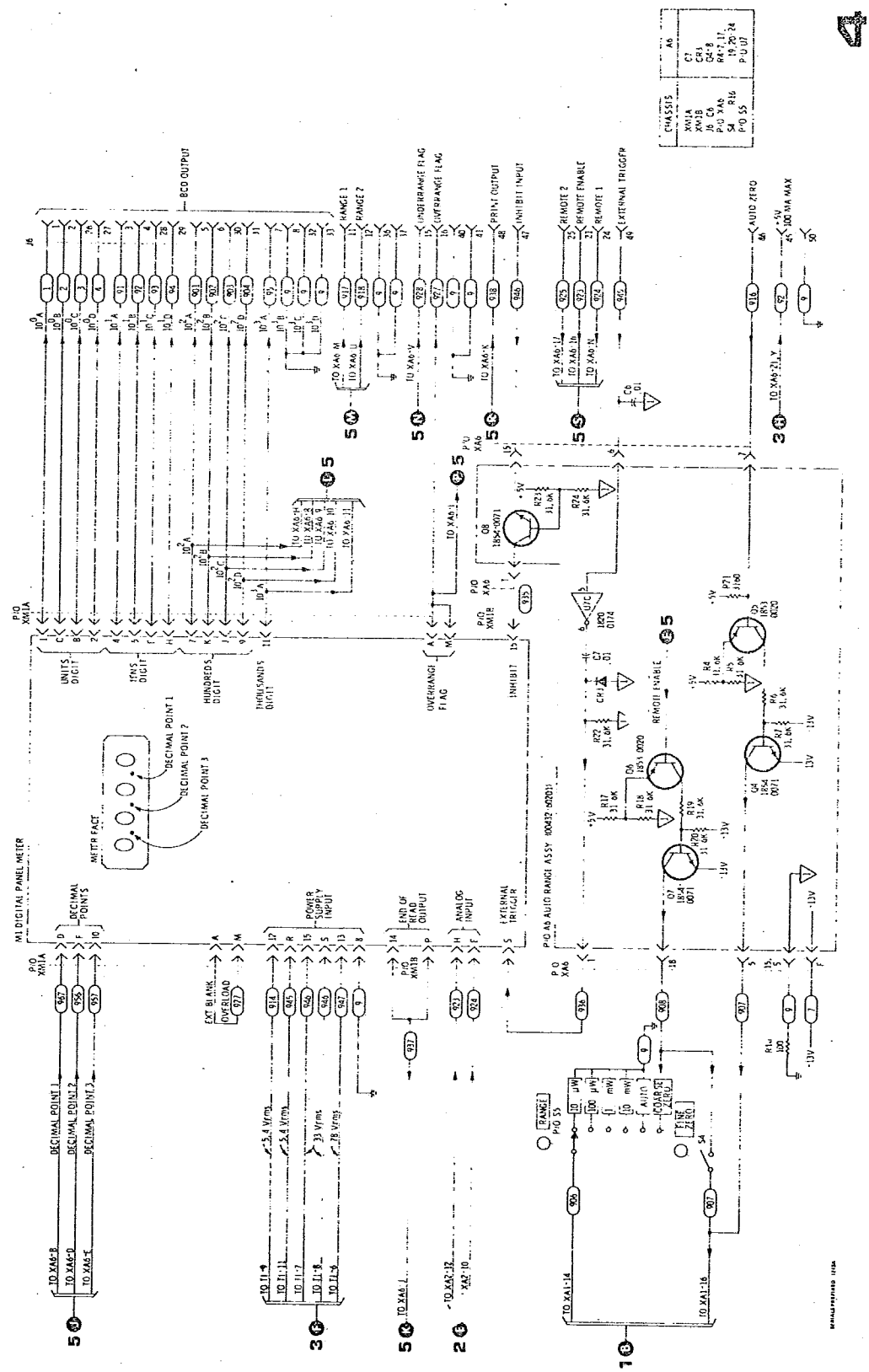


Figure 12. Digital Panel Meter M1 and Connector J6 Interconnections (Part of Change 1)

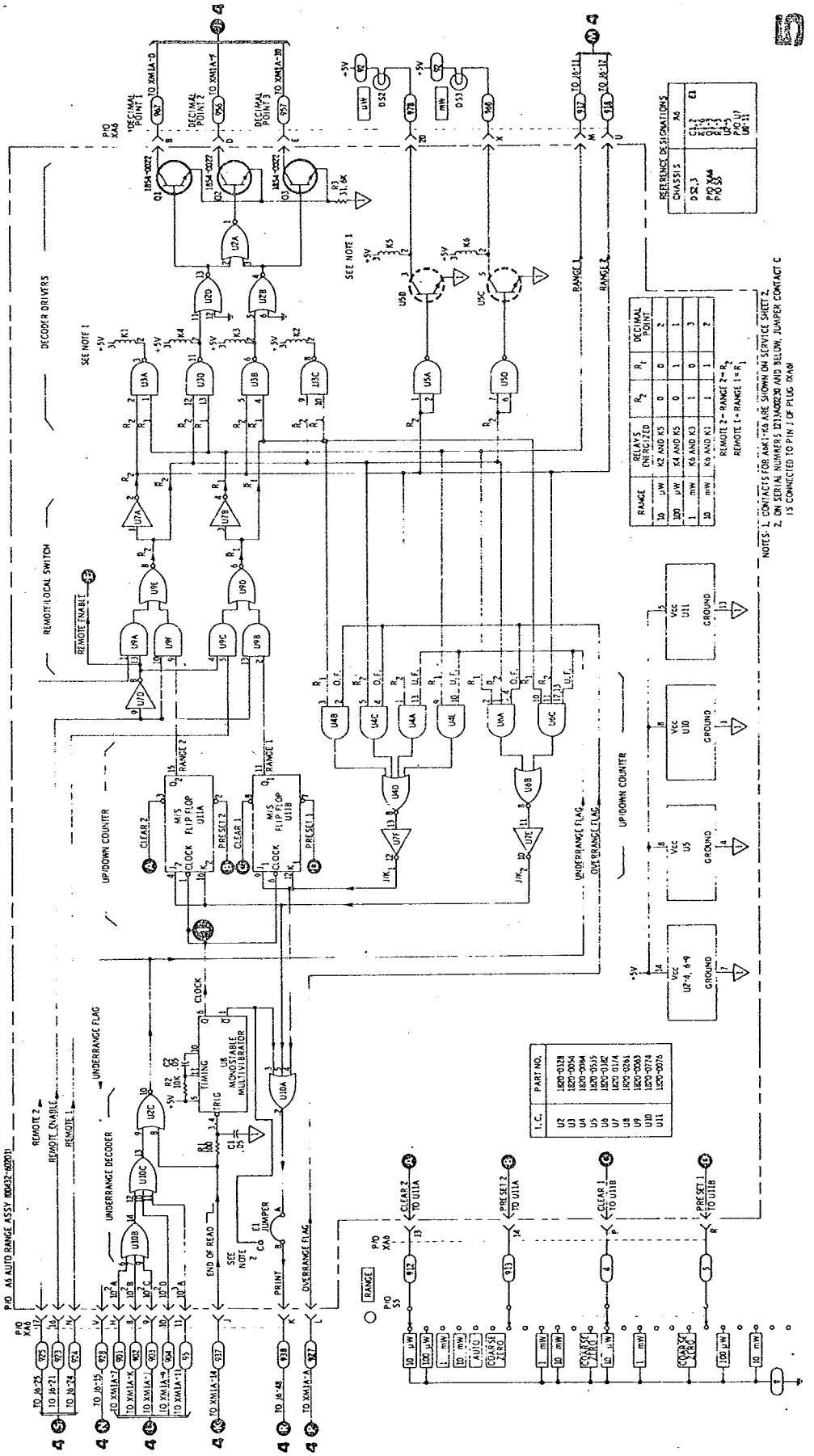
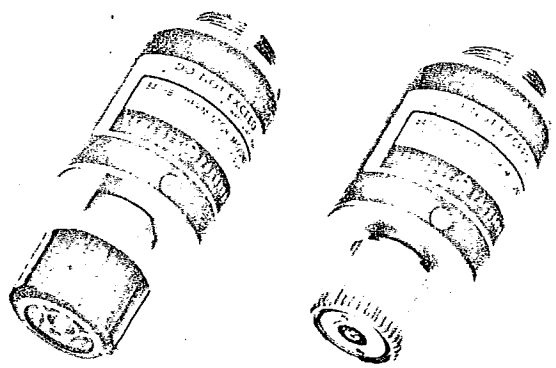


Figure 14. Auto Range Circuits (Part of Change 2)

OPERATING NOTE

THERMISTOR MOUNT

8478B



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HEWLETT hp PACKARD

HP 8478B

GENERAL INFORMATION

1. INTRODUCTION.

2. The HP Model 8478B Coaxial Thermistor Mount is designed for use with HP Model 431 and 432 Power Meters to measure microwave power from 1 μW to 10 mW. Design of the mount minimizes adverse effects from environmental temperature changes during measurement. For increased measurement accuracy, Effective Efficiency and Calibration Factor are measured for each mount, and at selected frequencies across the operating range; the results are marked on the label of the instrument (see Paragraph 39). The Model 8478B can be used over the 10-MHz to 18 GHz frequency range. Throughout the range, the mount terminates the coaxial input in a 50-ohm impedance, and has a SWR of not more than 1.75 without external tuning.

3. Each mount contains two series pairs of thermistors, which are matched to cancel the effects of drift with ambient temperature change. Thermal stability is accomplished by mounting the leads of all four thermistors on a common thermal conductor to ensure a common thermal environment. This conductor is thermally insulated from the main body of the mount so the thermal noise or shocks applied externally to the mount, such as those from handling the mount manually, cannot significantly penetrate to disturb the thermistor. This thermal immunity enables the thermistors to be used in the measurement of microwave power down to the microwatt region.

4. The 8478B operates directly with 431C and 432A Power Meters. Model 11527A adapter is used for operation with 432A/B Power Meters.

5. INCOMING INSPECTION.

6. Inspect the Model 8478B upon receipt for mechanical damage. Also check it electrically; if the mount was subjected to severe mechanical shock during shipment, the match between the thermistors may be affected. To check thermistor match, proceed as described in Paragraph 72.

7. If any damage is found, inform the carrier and your nearest HP Sales and Service Office immediately.

OPERATION

8. PRECAUTIONS.

9. Mechanical Shock.

10. DO NOT DROP OR SUBJECT TO SEVERE MECHANICAL SHOCK. SHOCK MAY DESTROY THE MATCH BETWEEN THERMISTORS AND INCREASE SUSCEPTIBILITY TO DRIFT.

11. Biasing Thermistors.

CAUTION

Before connecting the 8478B to a 431C or 432A Power Meter, set MOUNT RES switch to 200Ω BAL (431) or 200Ω (432) position. When using the 8478B with a 431A/B or 430 Power Meter, use Model 11527A or 11528A Adapter respectively and set MOUNT RES switch to 200Ω position. CONNECTING A 200-OHM MOUNT TO A POWER METER SET FOR A 100-OHM MOUNT CAN RESULT IN THERMISTOR DAMAGE.

12. Maximum Input.

13. The Model 8478B/431 and 8478B/432 combinations respond to the average RF power applied. The maximum signal applied to the thermistor mount should not exceed the limitations for 1) average power, 2) pulse energy, and 3) peak pulse power. Excessive input can permanently damage the Model 8478B by altering the match between the RF and compensation thermistors (resulting in excessive drift or zero shift) or cause error in indicated power.

14. Average Power.

15. The 8478B/431 and 8478B/432 combinations can measure average power up to 10 mW. To measure power in excess of 10 mW, insert a calibrated directional coupler such as one of the HP Model 790 series or one of the 8491 series coaxial attenuators between the mount and the source. UNDER NO CIRCUMSTANCES APPLY MORE THAN 30 mW AVERAGE POWER TO THE MOUNT.

Table 1. Specifications

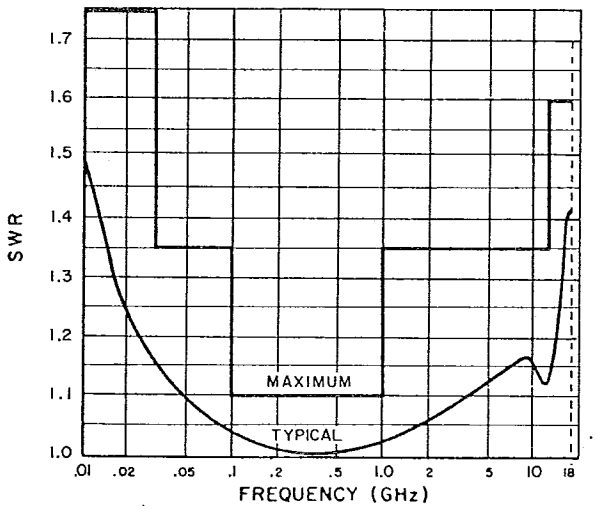
SPECIFICATIONS

Frequency Range: 10 MHz to 18 GHz.

Mount Calibration: Calibration Factor and Effective Efficiency furnished at seven frequencies across the band. Maximum uncertainty of data:

Calibration Factor	Effective Efficiency	Power Meter Range (mW)
±1.5%	±2.5%	10
		3
		1
±2%	±3%	0.3
±3%	±4%	0.1
±4%	±5%	0.03
		0.01

Input Impedance: 50 ohms.



SWR Limits

Maximum Reflection Coefficient:

10 to 30 MHz: 0.273 (1.75 SWR, 11.3 dB return loss).

30 MHz to 100 MHz: 0.15 (1.35 SWR, 16.5 dB return loss).

100 MHz to 1 GHz: 0.048 (1.1 SWR, 26.4 dB return loss).

1 to 14.4 GHz: 0.15 (1.35 SWR, 16.5 dB return loss).

12.4 to 18 GHz: 0.230 (1.6 SWR, 12.8 dB return loss).

Operating Resistance: 200 ohms. Balanced.

Power Range with Model 431 or 432: 1 μW to 10 mW.

Maximum Peak Power: 200 W.

Maximum Average Power: 30 mW.

Maximum Energy per Pulse: 10 W-μsec for a PRF ≥1 kHz; 5 W-μsec for a PRF <1 kHz.

Elements: Thermally balanced thermistor assembly. Thermisto· assembly is field adjustable so that full zero-set capability can be restored in the event of inadvertent overload.

RF Connector. Stainless steel type N male (APC-7 also available - see Option 11 below).

Output Connector: Mates with power meter cable (operates directly with 431C and 432A; for operation with 431A/B, see accessories available below).

Weight: Net 5 oz (140 g). Shipping 1 lb (450 g).

Accessories Available: 11527A Adapter, adapts 8478B to 431A/B.

Accessories Available:

11527A Adapter, adapts 8478B to 431A/B.

11528A Adapter, adapts 8478B to 430 Series Power Meters.

Option 11: 8478B Thermistor Mount supplied with APC-7 RF connector.

16. Pulse Energy and Peak Power for 8478B/432 Combination.

17. For pulses shorter than 250 μs, energy per pulse must not exceed 10 W-μs and peak power should never exceed 200 watts. (For example, a 40 mW, 250 μs pulse contains 10 W-μs of energy.) Pulses longer than 250 μs are allowed to contain more energy but peak power must not exceed 200 watts. Figures 1 and 2 interpret these limits in graphical form. (For lack of space, the mount nameplate lists only a 5 W-μs limit, a rating which applies to the 8478B/432A combination.)

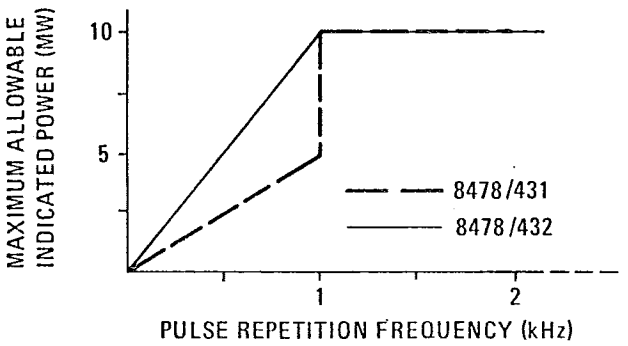


Figure 1. Maximum Power Meter Reading vs PRF for Pulses Shorter than 250 μsec

18. Pulse Energy and Peak Power for 8478B/431 Combination.

19. The limitations of this combination are basically the same as the 8478B/432 with the exception that at pulse repetition rates less than 1 kHz, energy per pulse must not exceed 5 W-μs and peak power must not exceed 10 mW. These limits are also interpreted in Figures 1 and 2.

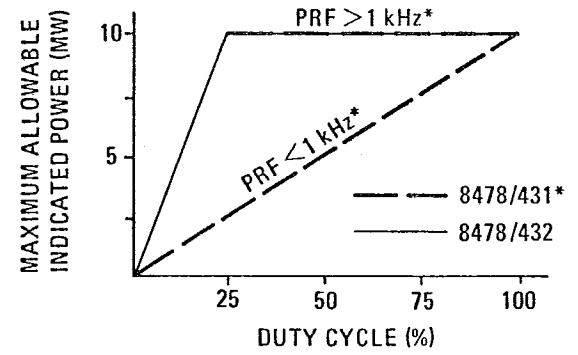


Figure 2. Maximum Power Meter Reading vs Duty Cycle for Pulses Longer than 250 μsec

20. Square-wave modulation is a special case of pulse modulation, and maximum power-meter reading versus square-wave frequency is illustrated in Figure 3. This figure also holds for sine-wave modulation.

21. In the discussions above, the primary consideration is maximum power or energy. However, for modulation frequencies less than 100 Hz, the low repetition frequency itself causes errors in indicated power. These errors may be as large as two percent regardless of range or reading.

22. When RF is switched by pulse-gating (coaxial solid state switches), consideration must be given to the RF energy contained in the switching pulse itself. This energy must be added to actual RF pulse power when estimating the RF power dissipated in the thermistor mount. PIN diode modulators of HP Model 8741A/8716A Modulators and 8614A/8616A Signal Generators, however, are not subject to this consideration because output filtering prevents transmission of modulating signals.

23. DRIFT PRECAUTION.

24. Thermistors are inherently temperature-sensitive devices. A cold thermistor mount connected to a warm piece of equipment, or vice versa, produces rapid drift. FOR MINIMUM DRIFT ON SENSITIVE RANGES, MAKE SURE THAT THE MOUNT AND THE EQUIPMENT CONNECTED TO IT ARE AT NEARLY THE SAME TEMPERATURE BEFORE MAKING A MEASUREMENT.

25. Unbalanced Operation with 431A/B or 430 Power Meters.

26. If the 8478B is used with a Model 431 Power Meter, a Model 11527A Adapter is required. If the 8478B is used with a 430 Power Meter, a Model 11528A Adapter is required. The use of an adapter breaks the balanced circuit and an unbalanced circuit results. In this unbalanced condition, a large amount of 10 kHz audio bias signal may be coupled from the power meter to the RF source output.

27. The RF source 10 kHz output impedance forms a parallel circuit shunt across one of the detection thermistor elements. If the RF source presents a 10 kHz impedance of 15K ohms or greater, the audio bias voltage appearing at the RF input connection is typically 1.3V rms. For an RF source 10 kHz impedance of 50 ohms, the audio

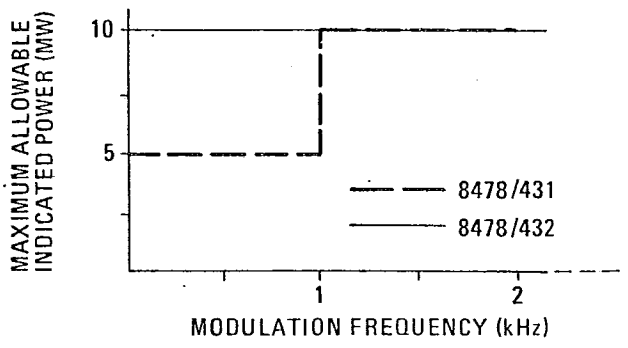


Figure 3. Maximum Power Meter Reading vs Square and Sine-Wave Frequency

bias voltage is greatly reduced to typically 5 mV rms. The presence of a large 10 kHz audio bias voltage at the RF source output may affect solid state RF sources and RF voltmeter measurements. To minimize or eliminate these effects, use a high-pass filter at the RF source output.

28. A variation in 10 kHz impedance at the RF input connection affects the power meter RF detection bridge circuit. This causes a shift in the power meter zero setting. Refer to the following paragraphs for the proper power meter zero procedure when the 8478B is operated with the 11527A or 11528A Adapter.

29. ZERO-SET.

30. It is necessary to electrically zero-set the Model 431/432 Power Meter before making a power measurement. To preserve the same zero reference throughout the measurement, maintain the same thermal environment when RF power is pplied. Two recommended setups for 431 zero-setup are presented in Paragraphs 31 and 35. The recommended setup for zero-set in the 432 is shown in Paragraph 37.

31. RF Power Turned Off For Zero-Set.

32. There is minimum zero drift when the zero is set with the RF system connected to the thermistor mount and the RF power switch off or greatly attenuated by the generator attenuator. The methods used to switch off RF output in HP signal generators are listed in Table 2. After allowing time for the mount to stabilize thoroughly, follow zero-set procedures in the 431 or 432 Power Meter manual and then turn on the RF source.

33. 8478B with Model 431A/B and 430 Power Meters.

34. The Model 11527A or 11528A Adapter is required when operating the 8478B with the 431A/B or 430 Power Meters respectively. When the RF source presents a high 10 kHz output impedance of 100K ohms or greater, the power meter may be zeroed with the 8478B disconnected from the RF source and unterminated as explained in the previous paragraph. If the RF source presents a low 10 kHz impedance of 1K ohm or less, a zero setting made with the 8478B disconnected from the RF source and unterminated will not be the proper zero setting for power measurement. This error can be eliminated by terminating the 8478B in an impedance that approximates the RF source impedance at 10 kHz while zeroing the power meter. For example, if the RF source 10 kHz impedance is 50 ohms, terminate the RF input connection to the 8478B with a 50 ohm resistor.

35. 8478B with Model 431C Power Meter.

36. When it is inconvenient to turn off RF power in the RF source, connect the 8478B to the RF source and set 431C Power Meter RANGE switch to obtain an approximate midscale reading. When the reading does not drift, disconnect the 8478B from the source, zero the power meter, and immediately reconnect the mount to the RF source for the power measurement.

Table 2. Methods of Switching Off RF Output of Various HP Signal Generators

HP Generator	Frequency Range	Procedure to Switch Off RF Output
Model 606	50 kHz to 65 MHz	Increase the generator output attenuation 30 or more dB
Model 8614A/8616A Model 614/616 Model 618/620	800 to 2400 MHz/1800 to 4500 MHz 800 to 2100 MHz/1800 to 4200 MHz 3.8 to 7.6 GHz/7 to 11 GHz	Release RF pushbutton Set modulation selector to OFF Set modulation selector to OFF
Model 608 Model 682/687	10 to 480 MHz/10 to 420 MHz 1 to 2 GHz/12.4 to 18.0 GHz	Set MOD SELECTOR to PULSE, but do not apply modulation signal to modulation input terminal
Model 612	450 to 1230 MHz	Set MOD SELECTOR to PULSE 2, but do not apply modulation signal to modulation input terminal
Model 690, 8690 Series	1 to 20 GHz	Set LINE to STANDBY

37. 8478B/432.

38. When it is inconvenient to turn the RF power off while using the 8478B/432 combination simply remove the mount from the source, and using the COARSE and FINE ZERO, zero the 432.

39. MOUNT CALIBRATION DATA.

40. The calibration points imprinted on the label of each 8478B allow power measurements to be made with increased accuracy. Values of Calibration Factor and Effective Efficiency are given at seven frequencies between 10 MHz and 18 GHz. The mounts are tested on a swept-frequency basis to assure accurate interpolation between calibration points. Calibration Factor and Effective Efficiency values are traceable to the National Bureau of Standards to the extent allowed by the Bureau's calibration facilities.

41. Calibration Factor.

42. Calibration Factor is the ratio of substituted audio or dc power in a thermistor mount to the microwave RF power incident upon the mount.

$$\text{Calibration Factor} = \frac{P_{dc}\ \text{Substituted}}{P_{\mu wave}\ \text{Incident}}$$

43. Calibration Factor is a figure of merit assigned to a thermistor mount to correct for the following sources of error: 1) RF reflected by the mount due to mismatch, 2) RF loss caused by absorption within the mount but not in the detection thermistor elements, and 3) dc-to-microwave power substitution error. Calibration Factor is applied as a correction factor to all measurements made without a tuner. When these factors and thermoelectric effect (refer to Paragraph 53) are taken into consideration, the power indicated is the power that would be delivered by the RF source to the characteristic impedance of the transmission line. The total SWR in the transmission line determines a region of uncertainty about the measured power. This subject is discussed in Application Note 64, available from any Hewlett-Packard Sales and Service Office.

44. Effective Efficiency.

45. Effective Efficiency is the ratio of substituted audio or dc power in a thermistor mount to the microwave RF power dissipated within the mount.

$$\text{Effective Efficiency} = \frac{P_{dc}\ \text{Substituted}}{P_{\mu wave}\ \text{Dissipated}}$$

46. Effective Efficiency corrects for power absorbed in parts of the mount other than the detection thermistor elements and dc-to-microwave power substitution error in the thermistor mount. Effective Efficiency is applied as a correction factor when a tuner is used to match the thermistor mount to the transmission line or RF source. In this case, all of the RF power incident upon the mount is absorbed in the mount. Since all power is absorbed in the mount, measurement uncertainty due to mount SWR is eliminated; however, losses in the tuner must be considered.

47. CALIBRATION DATA APPLICATION.

48. When the 8478B is used with the Model 431 or 432 Power Meters, Calibration Factor or Effective Efficiency corrections can be made by setting a front panel switch. With the proper setting, the 431 or 432 compensates for the Calibration Factor or Effective Efficiency in the 8478B. If the 8478B is used with a power meter other than the 431 or 432, Calibration Factor or Effective Efficiency corrections can be made by dividing the measured power by the Calibration Factor or Effective Efficiency value respectively.

49. THERMOELECTRIC EFFECT.

50. When using 431 Power Meters, thermoelectric errors must be taken into consideration. Mount calibration uncertainties given in Table 1 include inaccuracies caused by thermoelectric effect error. Calibration Factor uncertainty of ±1.5% and Effective Efficiency uncertainty of ±2.5% can be maintained on the three lowest power ranges of the Model 431 series Power Meters by correcting for the measurement error introduced by thermoelectric effect. An error correction procedure is given in Paragraph 53.

51. A mild thermocouple exists at each point of contact where the connecting wires join to the thermistor elements. Each thermocouple creates a dc voltage. Thus, two thermocouple voltages of opposite relative polarity are formed, one at each junction to each thermistor element.

52. Ideally, each thermocouple voltage would be equal in magnitude so that they cancel with no resultant effect on the accuracy of power measurement. In practice, however, each point of contact does not have identical thermocouple characteristics, and in addition, the temperatures at each junction may not be the same. These differences cause an incomplete cancellation of the thermoelectric voltages, resulting in a voltage that causes a thermoelectric effect error. The magnitude of the error is important when making dc substitution measurements on the 0.1 mW, 0.03 mW, and 0.01 mW ranges with one of the Model 431 series Power Meters. On other ranges, the effect is negligible. Maximum error introduced by thermoelectric effect is about 0.3 μW and is typically 0.1 μW on the 0.01 mW range.

53. Thermoelectric Effect Error Correction for 8478B/431 Combination.

54. Use the following technique to correct for thermoelectric effect error.

a. Measure power.

b. Connect a HP Model 8402B Power Meter Calibrator to the power meter DC CALIBRATION AND SUBSTITUTION connector.

c. Zero and null power meter.

d. By dc substitution (refer to procedure in 431 Manual), duplicate power measurement made in step a. Calculate and record substituted power as

e. Reverse connection polarity between the calibrator and power meter.

f. Re-zero and re-null power meter, if necessary.

g. By dc substitution, duplicate lower measurement made in step a. Calculate and record substituted power as P_2.

h. Calculate arithmetic mean of the two substitution powers P_1 and P_2. This mean power includes a correction for thermoelectric effect error.

$$\text{Power} = \frac{P_1 + P_2}{2}$$

55. Thermoelectric Error for 8478B/432 Combination.

56. The thermoelectric errors present in the 431 are minimized in the 432 since the thermoelectric voltage is negligible compared with the dc voltage used to bias the thermistor bridges.

OPERATING PRINCIPLES

57. GENERAL OPERATION.

58. Two matched pairs of thermistor elements are used in the 8478B. Each pair is connected in series and the two pairs are mounted in a common thermal conducting block. The thermistor pairs are used in the bridges of the power meter. One pair, the detection thermistors, is used as an arm of the RF detection bridge. The other pair, the compensation thermistors, is used as an arm of the compensation and metering bridge. The RF detection bridge balance is affected by RF power input to the 8478B, and the bridge is balanced by the application of 10 kHz audio bias power. The compensation and metering bridge is indirectly, but equally affected, by the application of RF power. Deviation from a near-balance condition is caused by an equal change in the 10 kHz audio bias power to the compensation thermistor pair, as initiated by the RF detection bridge. The compensation and metering bridge is returned to near-balance by the application of dc power.

59. With the 8478B attached to the 432 Power Meter the detection thermistors are part of the RF bridge and the compensation thermistors are part of the compensation bridge. Since the two pairs of thermistors show the same thermal environment, any change in temperature which affects the RF bridge simultaneously affects the metering bridge; this allows the power meter circuit to compensate for changes in temperature and thus minimize drift.

60. During 8478B/431 operation, sufficient amounts of dc and 10 kHz bias currents are supplied from the 431 Power Meter to heat the thermistors until their resistances are reduced to approximately 200Ω per series pair. Capacitor C3 offers high impedance to 10 kHz, but is practically a short to RF. This causes "D" to appear series connected to 10 kHz, but parallel connected to RF. In this manner, "D" appears to the audio bridge of the 431 Power Meter as a 200Ω resistance, but terminates the coaxial cable in 50Ω. Capacitor C1 blocks any dc and audio power that may be present in the incoming signal, and passes only RF power.

61. During operation sufficient amounts of dc current are supplied from 432 Power Meter to heat the thermistors until their resistances are reduced to approximately 200Ω per series pair. Capacitor C1 is practically a short to RF. This causes "D" to appear series connected to the dc bridge, parallel connected to RF. In this manner, "D" appears to the dc bridge in the 432 Power Meter as a 200Ω resistance that terminates the coaxial cable into 50Ω. Capacitor C1 blocks any dc and audio power that may be present in the incoming signal and passes only RF power.

62. 431 Power Meter Detector

63. Under normal operation, the total power supplied to heat thermistor pair "D" (see Figure 4) consists of: 1) RF signal, 2) 10 kHz bias, and 3) heat from the environment. The total power supplied to heat thermistor pair "C" consists of: 1) dc bias, 2) an equal amount of 10 kHz bias, and 3) heat from the same environment. As "D" and "C" are matched thermally, the total amounts of heat applied to reduce their series resistance equally must be equal.

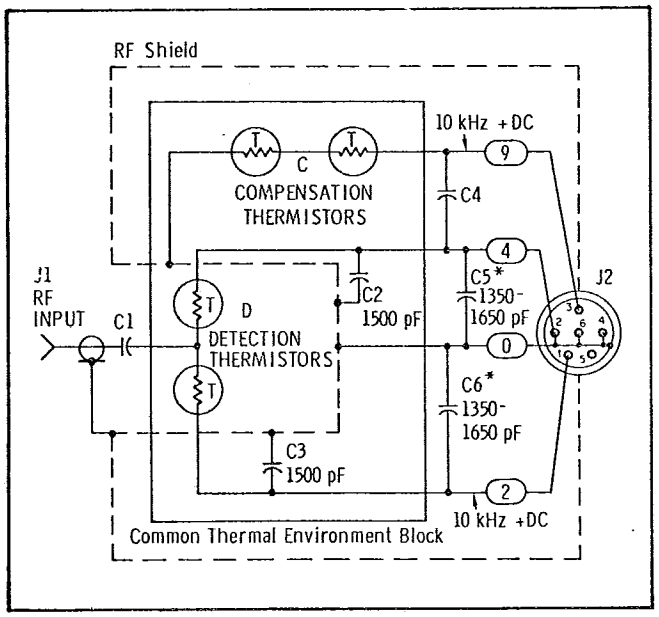


Figure 4. 8478B Connected to a 431C Power Meter

64. 432 Power Detection.

65. Under normal operation, the total power applied to heat thermistor pair "D" (see Figure 5) consists of: 1) RF signal, 2) heat from the environment, and 3) dc bias. The total power supplied to heat thermistor "C" consists of: 1) dc

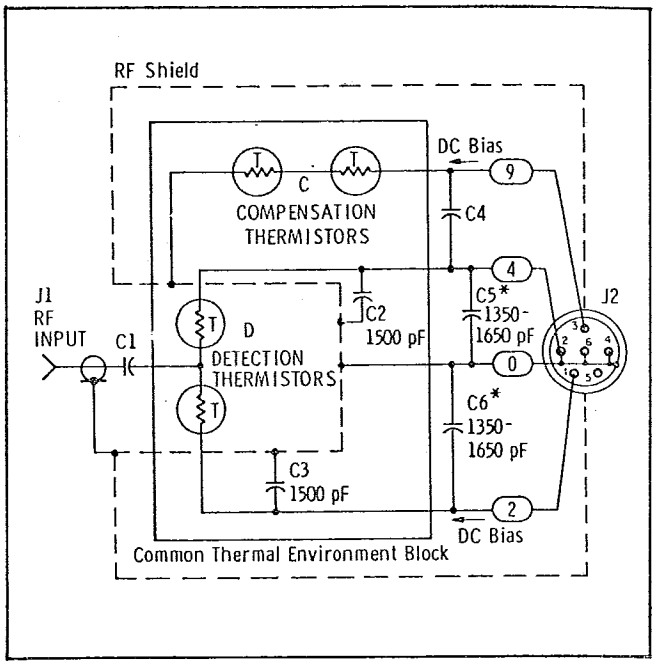


Figure 5. 8478B Connected to a 432A Power Meter

bias, and 2) heat from the same environment. As "D" and "C" are matched thermally, the total amounts of heat applied to reduce their series resistance equally must be equal.

MAINTENANCE

66. MECHANICAL SHOCK.

67. The Model 8478B is a precision instrument. Avoid dropping or other mechanical shocks. Such shocks can destroy the resistive match between thermistor elements, or otherwise degrade performance.

68. Test equipment and accessories required to perform maintenance are listed in Table 3. Equipment other than recommended models can be used provided the critical specifications are satisfied.

NOTE

The following procedures are set down for the 8478B/431 combination. The same procedures can be used for the 432 except for the ZERO/VERNIER control. These controls on the 431 are replaced by the COARSE ZERO and FINE ZERO control on the 432.

Table 3. Recommended Test Equipment

Instrument Type	Critical Specifications	Recommended HP Model
Sweep Oscillator	Accuracy: ±1% full scale for all RF Units Leveling Capabilities Frequency Range: 8 GHz to 18 GHz	8690A, 8694A, 8695A
SWR Meter	Sensitivity: 0.15 uV for full scale deflection Accuracy: ±0.05 dB/10 dB step Range: 70 dB in 10 dB steps	415E
Directional Detector	Frequency Range: 8.0 to 12.4 GHz Maximum SWR: 1.25:1	789C
Directional Coupler	Frequency Range: 12.4 to 18 GHz 10 dB Coupler SWR: <1.05:1	P752C
Carriage	Accepts HP 816A Slotted Line	809C
Slotted Line	Frequency Range: 8 to 18 GHz Impedance: 50 ohms ±0.2 ohms SWR: <1.06:1, 8 to 18 GHz	816A
Probe	Frequency Range: 8 to 18 GHz	447B
Passband Filter	Passband Frequency: 12.4 to 18 GHz	P362A
Crystal Detector	Frequency Range: 12.4 to 18 GHz	P424A
Waveguide to Coax Adapter	Frequency Range: 12.4 to 18 GHz Connector - Type N	P281B
Power Meter	Power Range: 10 mW Accuracy: ±1% of full scale	432A
Digital Voltmeter	Input Impedance: 10 Megohm Resolution: 4 significant digits Accuracy: ±0.05%	3440A/3443A
Power Supply	Output Voltage: 29 Vdc	6217A
Cables	1. Coax-Type N connectors 2. BNC-BNC - male connectors	11500A 10502A
Battery	Voltage +2.0 to 3.1 Vdc	See Paragraph 72
Resistor	2.2K ohm 5%	0698-4262

69. PERFORMANCE TESTS.

70. SWR Measurement, 8 GHz.

SPECIFICATION: SWR at 8 GHz = <1.35:1

DESCRIPTION: SWR measurement using standard SWR measurement techniques.

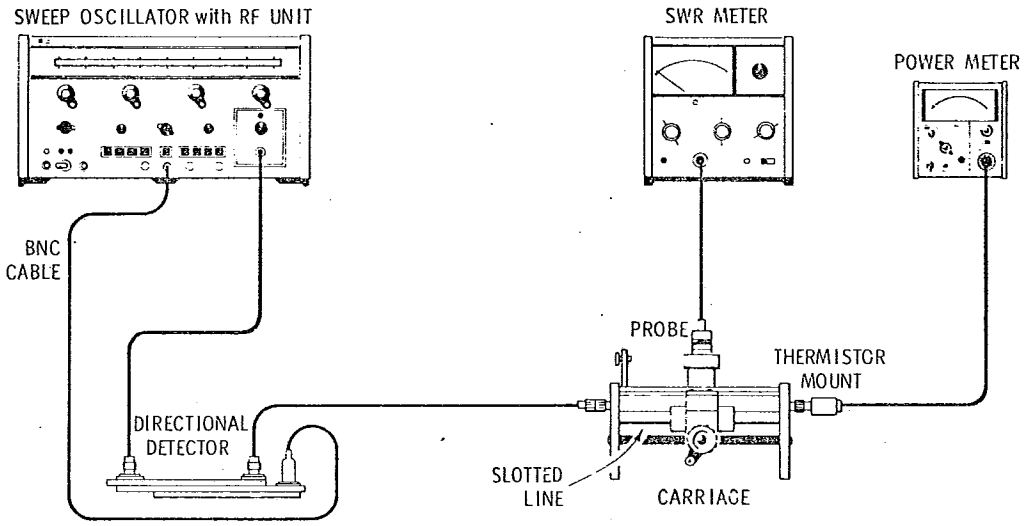


Figure 6. SWR Measurement Test, 8 GHz

PROCEDURE:

a. Connect the test equipment as shown in Figure 6. Make sure all connections are secured tightly.

b. Set the instrument controls as follows:

HP 8690B/8692A

SWEEP SELECTOR	CW
FUNCTION	START/STOP
ALC	IN
AMPLITUDE MOD	INT SQ WAVE
START/CW	8 GHz
POWER LEVEL	Adjust to maximum with the UNLEVELED light off

HP 415E

INPUT	XTAL IMPED - HIGH
RANGE-DB/EXPAND	30/NORM
GAIN/VERNIER	Centered

432A

MOUNT RESISTANCE	200 ohms
RANGE	10 mW

PERFORMANCE TESTS (cont'd)

c. Adjust the HP 8690B Sweep Oscillator INT SQ WAVE FREQ for a maximum reading on the HP 415E SWR meter.

d. Adjust the HP 447B Probe penetration for a half scale reading on the SWR meter.

e. Move the HP 809C Carriage adjustment for a maximum reading on the SWR meter.

f. Use the 415E GAIN/VERNIER controls to set the SWR meter reading to 1.0 SWR on the 415E meter.

g. Move the 415E RANGE-DB/EXPAND switch to 0. Adjust the GAIN/VERNIER controls for a 1.0 SWR reading.

h. Move the 809C carriage adjustment for a minimum SWR reading on the 415E. The SWR at 8 GHz should be less than 1.35:1.

HP 415E (8 GHz) _____ <1.35:1

i. Repeat steps a through h to determine the SWR at 12.4 GHz. The SWR at 12.4 GHz should be less than 1.35:1.

HP 415E (12.4 GHz) _____<1.35:1.

PERFORMANCE TESTS (cont'd)

71. SWR Measurement, 15 and 18 GHz.

SPECIFICATION: SWR at 15 and 18 GHz = 1.6:1 maximum.

DESCRIPTION: SWR measurement using standard SWR measurement techniques.

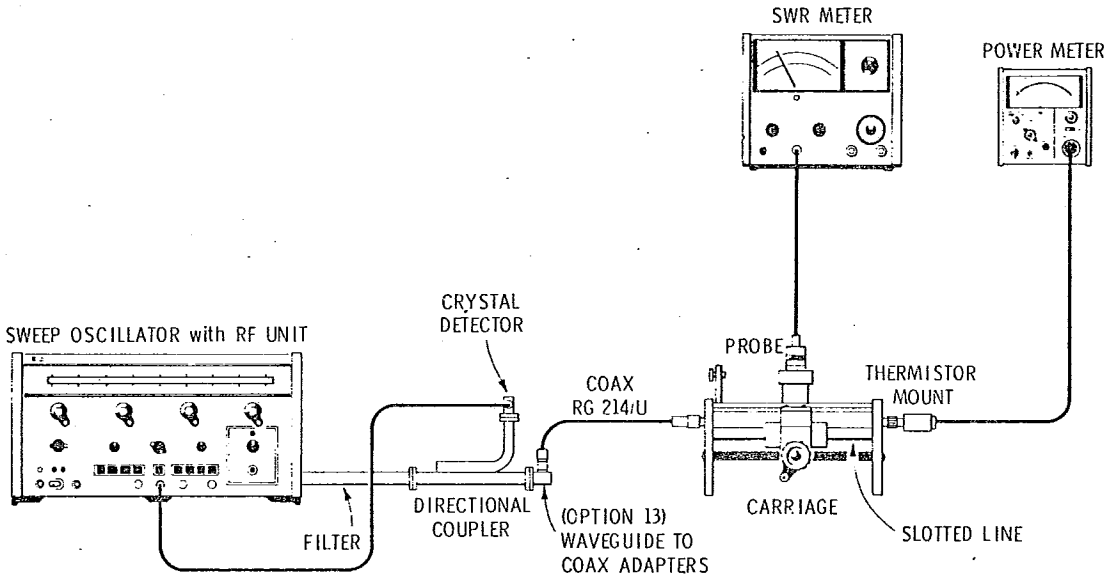


Figure 7. SWR Measurement, 15 and 18 GHz

PROCEDURE:

a. Replace the RF unit, filter and directional detector in the 12 GHz test setup with the instruments shown in Figure 8.

b. Repeat steps a through h to determine the SWR at 15 GHz. The SWR at 15 GHz should be 1.6:1 maximum.

HP 415E (15 GHz) _____ 1.6:1 maximum

c. Move the 8690B START/CW control to 18 GHz. Repeat steps a through h to determine the SWR at 18 GHz. The SWR should be 1.6:1 maximum.

HP 415E (18 GHz) _____ 1.6:1 maximum.

PERFORMANCE TESTS (cont'd)

72. Thermistor Resistive Match Test.

SPECIFICATION: Thermistor match ±0.5 ohm.

DESCRIPTION: The voltage drop across each thermistor is measured to check thermistor match.

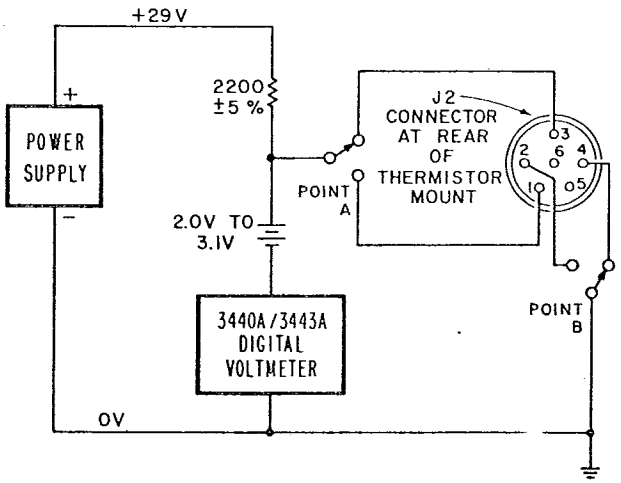


Figure 8. Thermistor Resistive Match Test

EQUIPMENT REQUIRED:

POWER SUPPLY	HP 6217A Power Supply
DIGITAL VOLTMETER	HP 3440A/3443A Digital Voltmeter
BATTERY	See Note
RESISTOR (2.2K ±5%)	HP 0698-4262

NOTE

The small battery connected in series with the DVM is in opposition to the power supply. The value of this reverse voltage should be selected to provide voltmeter resolution of 0.001 volt.

PERFORMANCE TESTS (cont'd)

72. Thermistor Resistive Match Test (cont'd).

a. Connect the equipment as shown in Figure 8. Set instrument controls as follows:

721A

METER RANGE . . . . . 30 VDC
VOLTAGE ADJUST . . . . . 29 VDC

3440A/3443A

RANGE . . . . . AUTO

b. Connect point A to pin 3 of the thermistor mount jack and point B to pin 4 of the thermistor mount jack.

c. Record the DVM Reading.

3440A/3443A _____

d. Connect point A to pin 1 of the thermistor mount jack and point B to pin 2 of the thermistor mount jack.

e. Record the DVM Reading.

3440A/3443A _____

f. Thermistor match (±0.5Ω) is satisfactory if the two readings do not differ by more than 0.03 volt.

Difference _____ <0.03 volt

73. TROUBLESHOOTING.

74. Exceeding the CW or pulse power limits of the Model 8478B Thermistor Mount may result in damage such that the mount will no longer zero on the power meter.

75. Before adjusting the mount in any way, make sure that the mount is the cause of the problem. An open or short indication, using the performance test or the check in Paragraph 78, means that the mount is not repairable by the procedure outlined in the following paragraphs. However, the mount may be non-operative, but still repairable. Test for this by using the thermistor resistive match test procedure, or by connecting the mount to a power meter and cable which are known to be good. A faulty cable will not have continuity through the respective connector pins, or may have poor contact at the mount connector. Poor contact will show up as intermittence or a great deal of noise (visible on the power meter) when the cable is gently flexed near the connector end.

76. To troubleshoot a damaged mount, proceed as follows:

a. Connect mount to Model 431C.

b. Set:
MOUNT RES . . . . . 200Ω BAL
RANGE . . . . . 10 mW
POWER . . . . . ON

c. Rotate ZERO from one limit to the other.

77. If meter remains pegged upscale, the thermistor elements have been damaged. However, it may be possible to recompensate the thermistors per Paragraphs 81 and 83 and return the mount to operation; otherwise they must be replaced. In either case, the Effective Efficiency and Calibration Factor data on the nameplate are no longer valid (refer to Paragraph 84).

78. If meter remains pegged downscale, measure resistance between pins 1 and 2, and pins 3 and 4. The resistance should measure between 1000 and 5000 ohms. An open or shorted reading indicates the need for replacement of the thermistors.

WARNING

Under no conditions should the mount be required to carry a current higher than 14 mA.

79. THERMISTOR COMPENSATION.

80. If the resistance reading is satisfactory, it may be possible to recompensate the mount, and return it to service. The drift with temperature changes will be higher because of the damage to the thermistors, but it will be possible to zero the meter and to make accurate measurements. The Effective Efficiency and Calibration Factor imprinted on the label will no longer be valid (refer to Paragraph 84). There are two adjusting screws which permit recompensation within limits.

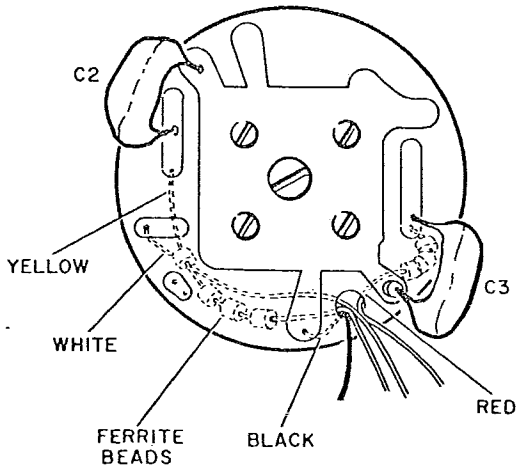


Figure 9. Printed Circuit Board

81. Refer to Figure 10, and proceed as follows:

a. Remove the three screws (A).

b. Slide terminal shield away from instrument.

c. Plug connector J2 into Model 431C.

d. Set:
MOUNT RES . . . . . 200Ω BAL
POWER . . . . . ON

82. If meter is pegged downscale:

a. Set RANGE to 10 mW.

b. Set ZERO and VERNIER to mid-range.

c. Turn screws (B) clockwise, 1/8 turn alternately.

CAUTION

If there is a sudden jump in meter indication when advancing either screw, back off 1/8 turn, and do not advance that screw further. Check resistance as in Paragraph 78. If either screw bottoms, do not apply force. Thermistor replacement is indicated.

d. When meter pointer rises, trim to zero with each adjusting screw.

e. Replace terminal shield and three screws (A). The instrument is now operative.

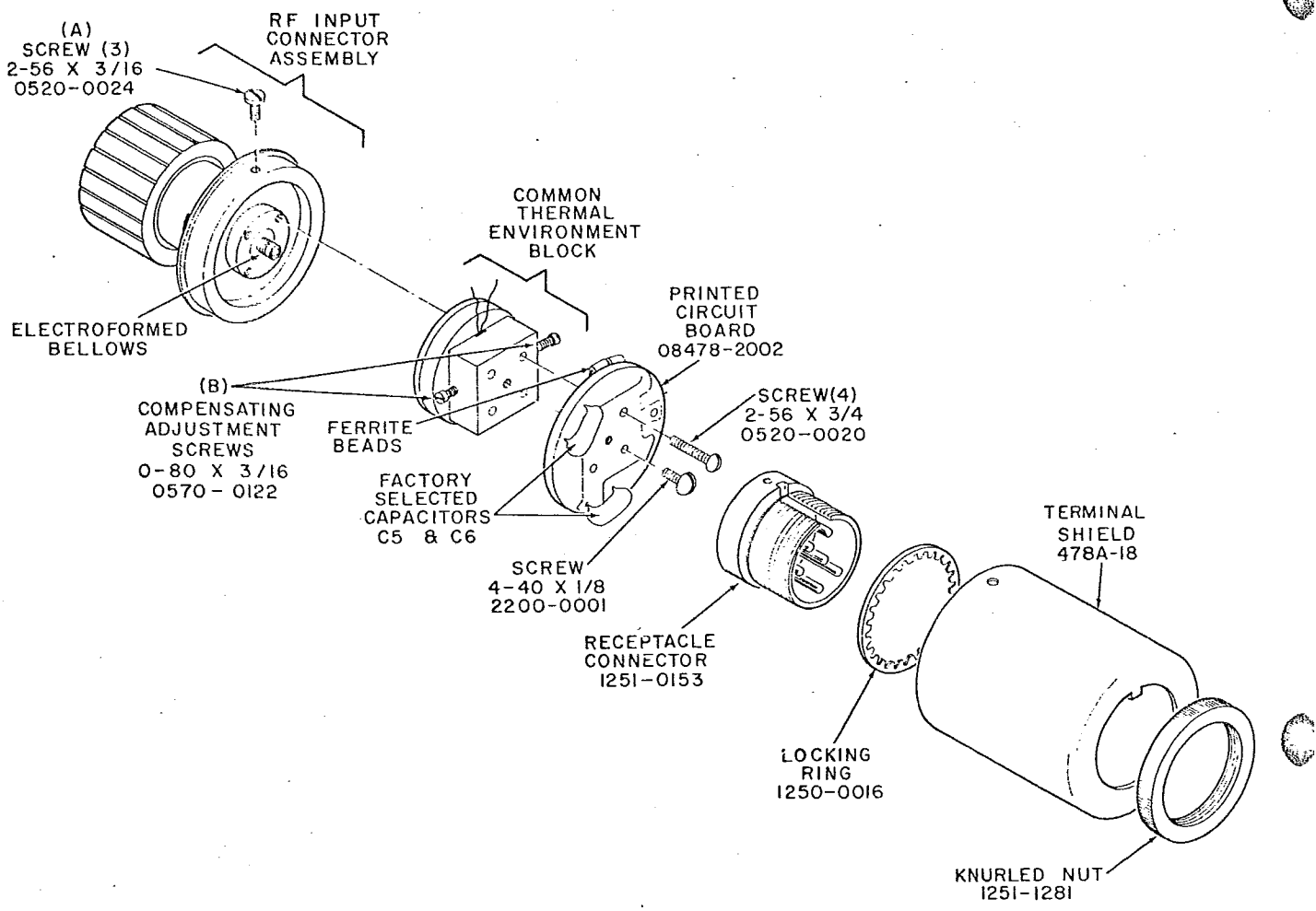


Figure 10. Thermistor Mount Assembly

83. If meter is pegged upscale:

a. Set meter pointer to mid-range.

b. Set RANGE to highest position which will not peg the meter. If meter pegs on all ranges, set RANGE to 10 mW.

c. Turn one of the screws (B) counterclockwise to obtain a meter reading half that observed in step b.

d. Turn the other screw (B) counterclockwise to zero the meter. If it is impossible to zero the meter, replace the thermistors.

e. Replace cover and three screws (A). The instrument is now operative.

NOTE

The three screws must be tight (use lock washers) for proper operation with 432A. If these screws are not tight noisy operation will occur.

84. FACTORY REPAIR AND RECALIBRATION.

85. If repair or recalibration of the mount is desired, the instrument may be returned to the factory for repair and recalibration, or for recalibration only. Arrangements can be made with any Hewlett-Packard Sales and Service Office.

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